PROCEEDINGS

OF THE

BOARD OF AGRICULTURE IN INDIA

HELD AT

PUSA

ON THE

6th January 1905 and following days,

WITH APPENDICES.

CALCUTTA:
PRINTED AT THE SUPERINTENDENT OF GOVERNMENT PRINTING, INDIA.
1905.

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No. C.—86, dated Pusa, the 12th January 1905.

From—F. G. Sly, Esq., I.C.S., Officiating Inspector General of Agriculture in India,

To—The Secretary to the Government of India,

Department of Revenue and Agriculture.

I have the honour to submit the Proceedings of the First Meeting of the Board of Agriculture held at Pusa on the 6th January and succeeding days. These proceedings have been recorded by the Secretary, Mr. E. J. Butler, Cryptogamic Botanist to the Government of India, and have been approved by the Board.

Proceedings of the First Annual Meeting of the Board of Agriculture held at Pusa on the 6th January 1905 and succeeding days.

List of Members.

1. F. G. Sly, Esq., I.C.S., *Officiating Inspector General of Agriculture in India, President of the Board.*
2. Dr. E. J. Butler, *Cryptogamic Botanist to the Government of India, Secretary to the Board.*
3. Colonel J. W. A. Morgan, M.R.C.V.S., *Inspector General, Civil Veterinary Department.*
4. B. Coventry, Esq., *Director, Agricultural Research Institute, Pusa.*
5. Dr. J. W. Leather, Ph.D., F.T.C., F.C.S., *Agricultural Chemist to the Government of India.*
6. H. M. Leefroy, Esq., M.A., F.E.Z., F.Z.S., *Entomologist to the Government of India.*
7. E. Shearer, Esq., *Agri.-Horticulturist, Agricultural Research Institute, Pusa.*
8. Captain A. T. Gage, I.M.S., *Officiating Superintendent, Royal Botanic Garden, Calcutta.*
9. A. Pedler, Esq., C.I.E., F.R.S., *Director of Public Instruction, Bengal.*
10. S. L. Maddox, Esq., M.A., I.C.S., *Director of Land Records and Agriculture, Bengal.*
11. F. Smith, Esq., *Deputy Director of Agriculture, Bengal.*
12. C. J. Bergtheil, Esq., *Agricultural Bacteriologist, Agricultural Research Institute, Pusa.*
13. Captain A. S. Trydell, M.R.C.V.S., *Superintendent, Civil Veterinary Department, Bengal.*
14. N. G. Mukerji, Esq., M.R.A.C., *Assistant to the Director of Land Records and Agriculture, Bengal.*
15. D. N. Mookerji, Esq., M.R.A.C., *Assistant to the Director of Land Records and Agriculture, Bengal.*
16. N. N. Banerjie, Esq., M.R.A.C., *Superintendent, Sripur Farm, Hathwa Raj, Bengal.*
17. W. H. Moreland, Esq., B.A., C.I.E., I.C.S., *Director of Land Records and Agriculture, United Provinces.*
18. J. M. Hayman, Esq., *Deputy Director of Agriculture, United Provinces.*
19. W. C. Renouf, Esq., I.C.S., *Director of Land Records and Agriculture, Punjab.*

20. H. M. LEAKE, ESQ., *Economic Botanist, United Provinces and Punjab.*
21. H. S. LAWRENCE, ESQ., I.C.S., *Director of Land Records and Agriculture, Bombay.*
22. F. FLETCHER, ESQ., M.A., B.Sc., *Deputy Director of Agriculture, Bombay.*
22. G. A. GAMMIE, ESQ., F.L.S., *Professor of Botany and Agriculture, College of Science, Poona.*
23. C. BENSON, ESQ., M.R.A.C., *Deputy Director of Agriculture, Madras.*
24. C. A. BARBER, ESQ., M.A., F.L.S., *Botanist to the Government of Madras.*
25. J. MACKENNA, ESQ., M.A., I.C.S., *Director of Land Records and Agriculture, Burma.*
26. F. C. HENNIKER, ESQ., I.C.S., *Director of Land Records and Agriculture, Assam.*
27. RAI BAHADUR B. C. BASU, M.R.A.C., *Assistant to the Director of Land Records and Agriculture, Assam.*
28. DR. A. LEHMANN, *Agricultural Chemist to the Government of Mysore.*
29. H. H. MANN, ESQ., *Indian Tea Association.*

VISITORS.

30. J. WILSON, ESQ., I.C.S., C.S.I., *Secretary, Department of Revenue and Agriculture, Government of India.*
31. C. GREENWAY, ESQ., OF MESSRS. SHAW, WALLACE & CO.

} *present on the second and third days only.*

FIRST DAY.

PROGRAMMES OF THE IMPERIAL DEPARTMENT OF AGRICULTURE.

1. THE programmes of the following officers of the Imperial Department of Agriculture were considered :—

(*a*) THE DIRECTOR, PUSA RESEARCH STATION.

Mr. Coventry pointed out that the programme submitted by him and printed in the official draft of subjects to be considered by the Board, was a working programme for the current year and was intended primarily to indicate the work proposed in getting the land under cultivation prior to the institution of a fixed scheme of definite experiments, the estate at present not having been brought into a good cultivable condition so as to permit of a comprehensive scheme of experiments for the coming year.

2. Mr. Bergtheil suggested the inclusion of varietal experiments with indigo and in particular the attempt to improve the existing varieties or obtain new varieties by hybridization. The Board are of opinion that these experiments should be undertaken as soon as means are available for adequate supervision and chemical control of the work.

3. RESOLVED by the Board that it is desirable that the Pusa Institute should draw up, as soon as possible, the plan of the experiments to be carried out on the farm, and that specialists should be invited to submit any proposals for the inclusion of experiments which they considered to be desirable.

(*b*) THE AGRICULTURAL CHEMIST.

4. The Board have no remarks to offer on this programme. In response to an enquiry from Mr. Barber, Dr. Leather expressed his willingness to provide Madras with temporary assistance from his office in testing by chemical analysis the time necessary for the full ripening of sugarcane in certain parts of Madras.

(*c*) The Cryptogamic Botanist.

At the suggestion of the Assam Department, Dr. Butler undertook to arrange in the current year for a local investigation of the potato blight in Assam, and also at the request of the Bengal Department to visit Malda to investigate a mango disease.

The Board are of opinion that the scheme proposed by Dr. Butler for the growth of rust-resistant wheats is suitable for adoption at Hoshangabad in the Central Provinces and at a locality in the Punjab, and they suggest that the proposal be included in the programmes of these Provincial Departments.

(*d*) The Entomologist.

At the suggestion of the Assam Department, Mr. Lefroy undertook to arrange a tour for the local investigation of insect pests in Assam. Some information was supplied by him in answer to enquiries with regard to two serious rice pests in Bengal which are engaging his attention.

Programmes of the Provincial Departments of Agriculture.

The programmes submitted by the several Provincial Departments of Agriculture were considered.

Dr. Leather and Mr. Mann pointed out the general danger of attempting a large programme of work without a strong staff of specialists to control it and that past experience showed that the most important results were achieved by workers who gave their undivided attention to the solution of one or a few great problems. Several Provincial Directors agreed to bear this in mind in the framing of the future programmes.

(*a*) Bombay.

At Dr. Butler's request it was agreed to add a plot at one of the Poona farms for experiments with the wilt disease of *arhar* or *tur* (pigeon pea).

(*b*) United Provinces. (*c*) Bengal.

The Board have no remarks to offer on these programmes.

(*d*) Madras.

In connection with this programme the question of experiments in the growth and curing of tobacco was considered. The Board is of opinion that the proposed experiments in tobacco-curing are not likely to lead to any useful results until arrangements can be made for their prosecution under the guidance of a qualified tobacco-expert and a chemist. It is considered to be a matter of importance for the country at large, which should be taken up at the earliest opportunity.

(*e*) Punjab.

The Board have no remarks to offer on this programme.

(*f*) Burma.

Resolved that it is desirable that an Agricultural Department should be organised for this Province and that a staff of experts should be appointed to it.

(*g*) Central Provinces.

The Board are of opinion that the work of the Agricultural Department in this Province requires the assistance of supervision by expert officers.

(*h*) Assam.

The Board note that the programme provides for useful work but is to a great extent limited to the Hill Tracts and to a tropical plantation. There is no farm in the important cultivated plains.

RESOLVED that it is desirable that a sufficient expert staff should be appointed to permit of work being extended to the latter area.

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16. In the general discussion Mr. Benson raised the question of manurial experiments with particular reference to the conservation of cattle-manure, and suggestions were offered on this point by several members of the Board. The general opinion was that a layer of loose earth on the floor of the cattle sheds was most efficacious in preventing loss of urine. It was pointed out that for this purpose a *pucca* floor is not necessary.

17. Mr. Mann pointed out the danger of relying too much on the conclusions furnished by varietal experiments unless extended over a number of years.

18. The difficulty of obtaining uniformity of plots for experimental purposes was insisted on by Mr. Benson and Mr. Hayman, and Dr. Leather considered that the only method of obtaining reliable results was to extend the observations over a number of years and, wherever possible, to provide for their re-duplication.

19. In discussing the size of the plots to be employed in cattle manurial experiments, Dr. Leather considered one-tenth acre plots too small. Mr. Hayman said that if large plots were used, the dangers arising from inequalities of soil were intensified, and suggested where possible a double series of moderately large plots and small ones. Dr. Lehmann recommended that the plots should be long and narrow and as far as possible with intervening paths. Mr. Fletcher found this form unsuitable and gave instances where long end rows bordering upon fallow introduced serious errors into the results. Dr. Lehmann considered that the end row should be excluded from the results in all cases where these errors are likely to arise, and Mr. Barber gave as his experience at the Samalkotta farm that paths of uniform size between the sugarcane plots were required and did not affect the results.

20. The Board considers that it is a useful form of work for an Agricultural Department to test and, where successful, to supply improved forms of agricultural implements to cultivators.

JUTE CULTIVATION.

21. The question of the extension of jute cultivation from Bengal to some other parts of India was considered. The Bombay Department stated that they have no farm located in a suitable area to undertake experiments in growing this crop. The Board suggest that an experiment on a small scale should be started in Madras in order to test the suitability, for this purpose, of the Godaveri Delta. In regard to Burma it is considered advisable to await the establishment of an Agricultural Department before proceeding further in the matter.

22. Mr. Finlow, Special Jute Expert to the Bengal Government, gave an account of his investigation, which is printed as Appendix A to these proceedings.

The Board desire to place on record their opinion of the importance of continuing the investigation into the cultivation, chemistry and other problems connected with this important crop, for which purpose the services of an expert are necessary.

SECOND DAY.

IRRIGATION.

23. The subject of irrigation was considered by the Board. Mr. Moreland pointed out that it is important to remember that information is required from the Board on certain subjects for the use of the *Irrigation* Department. In the United Provinces only one method of measuring is accepted by the Irrigation Department—that of the passage of the water through tanks of known content. The Board consider that the matter might, with advantage, be discussed by each province with its Irrigation Department.

24. The President pointed out the difficulties arising from percolation in some irrigation experiments with paddy. Dr. Lehmann suggested trenching

between the plots about 2 feet deep and then making a puddled clay *bund*; but Dr. Leather considered it certain that in cases such as those mentioned by the President, percolation under the *bund* would occur unless the trench was carried so deep as to make it a considerable expense.

25. In Madras, Mr. Benson said one of the main problems was to introduce a change in the nature of crops grown under irrigation. At present it is mainly paddy land which is irrigated. Difficulties arose in dealing with the irrigation of land such as black cotton soil. Mr. Hayman suggested a trial of the Bundelkhand system by which the water was run into a hollow and thrown on the field with a *beri* or water basket. Another method mentioned was that of growing the crop on the slopes of ridges along which the water was carried, while the base of the furrow served to carry off the surplus water.

26. The Board consider that it is improbable that experiments in irrigation, such as are mentioned in Section II, paragraph 2 (i) of the Madras Department of Agriculture's programme for the current year, can be carried out by ryots in a satisfactory manner.

27. In discussing the subject of well irrigation, it was mentioned that artesian wells on the *Kazuza* system were successful in the Godavari Delta though they had failed in Bengal. The use of casing tubes was necessary where layers of sand were encountered. Mr. Chatterton's recommendations for the use of oil engines in well irrigation were mentioned, and Mr. Fletcher gave as an instance the engine in use at the Nadiad farm, which with a lift of 45 feet would work at about half the cost of the leather-bucket system on a well with a constant supply of water.

Veterinary.

28. In the consideration of matters relating to veterinary science, Colonel Morgan deprecated the attaching of undue importance to the possibilities of cross-breeding in India. Crossing with imported cattle especially had been, in general, a failure. They are extremely susceptible to rinderpest and usually die off. The one case in which success was claimed—the Taylor breed in the Patna District—is practically confined to Patna and has not been a success elsewhere. Mr. Maddox considered that the success of this breed in the first instance may have been due to unusually careful selection and the provision of very good pasture. They were, he thought, now chiefly used for milk and were not successful elsewhere. Mr. Bannerji stated that at Bankipur the breed is not much used for draft purposes, but chiefly for milk. There was no difference in fodder requirements. Mr. Bannerji stated that at Sripur cross-breeds between up-country and local cattle were a success for cart work. Mr. Renouf mentioned that at Hissar cross-breeding had been a total failure.

The Board is of opinion that the most satisfactory line of work from a general standpoint for the improvement of Indian work-cattle for agricultural purposes lies in the selection of indigenous cattle rather than in cross-breeding.

29. With regard to milch breeds of cattle, Colonel Morgan was of opinion that only two breeds in India were good—the Montgomery and the Gir. In Sripur, Mr. Bannerji had found that the Montgomery breed do not fall off much and remain still superior to the local breeds, and are particularly free from disease. On the other hand, some other breeds such as the Hansi fall off very much and are liable to disease. In Poona, Mr. Lawrence has found that the Sindi cattle are the best; the Aden breed has also given good results; Gir cattle have done badly; and the Montgomery breed has not been tried.

The Board is of opinion that it would be advisable to try experiments on a small scale in various parts of India for the acclimatization of superior breeds of Indian milch cattle, especially the Montgomery breed.

30. The question of the age for sending out bulls having been raised, Colonel Morgan was of opinion that it should be not before three or even three and a half years.

Extension and Improvement of Indian Cotton.

31. In connection with the extension and improvement of Indian cotton cultivation, the Board considered the work which has been and is being done by

each province. Mr. Moreland insisted on the fact that it is not a question the solution of which can be in any way hurried. In improving and extending Indian cottons, none can hope to hit upon the secret of success suddenly. It was a very old problem and had engaged attention in India for a long time. One reason for the slow progress, which could only be hoped for in India, was that the Indian cultivator was not a capitalist. In other countries the actual cotton grower could often experiment largely. Before Government can undertake the issue of seed, it must be established that the seed is suitable for the cultivator as well as for the manufacturer. Hasty recommendations were therefore dangerous, and if once a wrong suggestion were to be made, the effects would be found to remain for years in the minds of the cultivators.

The Board desires to place on record its sense of the dangers attending on the distribution to cultivators, of any variety of cotton, the suitability of which to its proposed environment has not been determined by adequate investigation.

32. Notes were submitted by the Provincial Dopartments outlining the work done and in progress by them for the extension and improvement of Indian cotton. These notes are printed in Appendix B.

BOMBAY.

33. The Board recognize that the experiments in the cultivation of Egyptian cotton in Sind have been remarkably successful, but they have not yet advanced to the stage where this cotton can be recommended for cultivation on a commercial scale. They note with satisfaction that the zamindars to whom the seed is being distributed appreciate the fact that the cultivation is experimental.

UNITED PROVINCES.

34. RESOLVED that the best lines for future work in the United Provinces are (1) hybridization, (2) Selection of seed of the indigenous variety, mainly for the purpose of improvement of yield; (3) the trial of the variety known as *bani* cotton.

MADRAS.

35. The Board suggest the desirability of extending work to the two cotton growing tracts of Coimbatore and Kistna.

BENGAL, PUNJAB, BURMA, CENTRAL PROVINCES, ASSAM.

36. The Board have no remarks to offer.

37. In the general discussion Mr. Fletcher dwelt on the difficulties which he had encountered in endeavouring to obtain fixity of type in the several different types of cotton plant which make up what is known as Khandesh cotton in Bombay and which is similar to the *jari* cotton of the Central Provinces, and to those cottons of the great area of the United Provinces and Bengal, which make what is commercially known as Bengals. He feared that the type might prove unfixable and hence lead to failure in attempting bush-to-bush selection with this variety. Professor Gammie was inclined to think that though difficult, success would eventually be attained. It was pointed out that this is the cotton found around Cawnpore which it appeared from Mr. Moreland's note had shown no appreciable improvement after some ten years' work. Mr. Greenway drew attention to the fact that the selection at Cawnpore had been for yield and staple combined, and considered that better results might be got with this type in selecting for yield. He considered that the co-operation of ginning mills might be usefully enlisted as was done in the Central Provinces, where an effort was made to separate the better supplies of cotton and to distribute the seed after ginning. Mr. Benson thought that no advantage could result from this in Madras where the mixture of types was so great. The difference in quality of different supplies received by the ginning mills was probably largely due to conditions of cultivation. Mr. Fletcher agreed with Mr. Benson, but thought that in some cases a field-to-field selection might result in some good. This was especially the case in districts with a fairly uniform type and without marked differences in land. The President said that in the Central Provinces some ginneries were helping by selecting the best of their

cotton supplies, removing stained lint, and ginning it separately for the supply of seed to the cultivators. The attempt was partly frustrated by the cultivators themselves, who mixed the inferior samples with the rest in order to obtain a better price. Mr. Fletcher pointed out that field-to-field selection could only have a slight effect as compared with plant-to-plant selection.

38. Mr. Moreland mentioned a feature which he has observed in the United Provinces of late in the period of cotton sowing. The best cultivators endeavour to sow with irrigation before the rains break, thereby lengthening the period of growth. He was of opinion that if a good medium staple be ever successful in the United Provinces, it must be sown before the rains.

39. Mr. Greenway outlined the experiments being undertaken by Messrs. Shaw, Wallace & Co., in Bengal and Assam. Tree cottons were being tried on several experimental farms. In Lower Bengal the tree cottons are said to succeed apparently in any soil. Some of them have turned out practically useless, while others show promise of giving the largest yield known to the world. This is however based on results obtained on a very small scale which have not yet been tested by larger experiments. He considered that the Behar experiments already carried out show that new American and Egyptian cottons have little chance of success. Their chief disadvantage is that they are too long in maturing. Mr. Lefroy mentioned that in the villages in Behar, he had noticed that the tree cottons were immune to a considerable degree to insects pests. *Caravonica* cotton, however, was extraordinarily susceptible to the attacks of a particular grub (the stem-weevil) from the effects of which he concluded that cultivation of this variety was not likely to be a success. As regards other varieties growing experimentally in Behar, he thought that, on the whole, there was promise for acclimatised Americans.

40. Mr. Greenway inclined to the view that Burma offers very small prospects for the development of the cotton cultivation, owing to the scantiness of the agricultural population, and the dearness of labour, which would probably necessitate the importation of Bengal labour, if it were desired to develope the cultivation to any considerable extent.

The President said that the deterioration of cotton, which has undoubtedly occurred in the Central Provinces in recent years from the point of view of the manufacturer, was not so much real deterioration as a substitution of an inferior for a superior type. The cultivation of the superior *bani* type has been to a great extent replaced by that of the inferior *jari* type, because the latter is the largest profit yielder. Mr. Greenway thought that one of the main reasons for this substitution was a mixture of seed of inferior varieties. If grown pure in sufficiently large quantities, the price would be greater. At present no distinction is made in price since the seed is mixed, and the cultivator gets no more for his fine *bani* than he does for his coarse *jari*. This can only be overcome by introducing a sufficient quantity of *bani* seed into any one locality so as to create a market for the pure yield. Mr. Greenway also pointed out that it often happened, quite apart from the ordinary market, that very short stapled cottons fetched what were practically fancy prices. The short staple sorts, such as the Assam hill cottons, were much in demand for admixture with woollen goods especially when the price of wool was high.

THIRD DAY.

42. The Board considered the following memorial of the British Cotton Growing Association forwarded with Government of India letter No. 1726, dated the 30th December 1904:—

Copy of letter, dated Manchester, the 20th September 1904, from J. Arthur Hutton, Vice-Chairman, the British Cotton Growing Association, to the Right Hon'ble Lord Curzon of Kedleston, G.M.S.I., G.M.I.E., India Office, Whitehall, London, S.W.

At a recent Meeting of the Indian Committee of this Association it was decided to try and make arrangements for a deputation to wait upon your Lordship, to lay before you the views of this Association as to the best means of increasing the quantity and improving the quality of the cotton grown in the Indian Empire. We very much regret that owing to the limited time

which remained at your disposal it was impossible to arrange such a meeting, and we have therefore decided to place our views before you in writing, and we trust that you will give the same your most careful consideration.

2. We do not think it necessary to dwell at any great length on the serious importance of the shortage which has occurred in recent years in the supply of raw cotton. The very fact that it was thought necessary to draw attention in His Majesty's speech from the Throne to the efforts of this Association to relieve that shortage, must convince everyone that this is a question of the very highest national importance, affecting the welfare not only of those directly engaged in the Cotton Trade, but of a very large proportion of the population of the country. Nor is it necesssary for us to do more than draw your Lordship's attention to the fact that the serious losses which this country has incurred during the last two years, owing to the bulk of the Cotton Mills having to run short time, must seriously react on the prosperity of India and of the rest of the British Empire, which are so largely dependent on this country for the disposal of their products.

3. We would respectfully draw your Lordship's attention to the fact that the quality of cotton produced in India during recent years has undoubtedly deteriorated in quality, with the result that the cultivator receives a lower price. Very careful enquiries have been made into the question by this Association and from every source of information this fact is confirmed. As far as we can judge from the information at our disposal, the principal cause of this deterioration is the use of mixed seed and poor methods of cultivation.

4. We cannot impress too strongly on your Lordship's attention the very great importance of a proper supply of carefully selected seed, for this is *the most vital factor* on which successful cultivation depends. In our opinion this question of the supply of seed is of such immense importance to the prosperity of the native cultivator that we are convinced that the Government of India should not delay one moment in taking the matter into its own hands. According to reports we have received the natives are dependent for their supplies of seed for sowing on public ginneries, where apparently all sorts and varieties of cotton are mixed together and no attempt is made for keeping the better seed on one side for sowing.

5. We would therefore suggest that steps should be taken to establish Government Seed Farms throughout all districts where cotton is grown. On such farms continual selection of the best seed can be made year by year and so ensure a supply of the best possible seed to the native cultivators, which must result in a steady improvement in the quality of cotton produced and an increase in the amount produced per acre. The consequently higher price and larger return must naturally result in greater prosperity to the farmer.

6. We wish to make it perfectly clear that we do not necessarily advocate that further larger attempts should be made to introduce exotic varieties. Much good will be done if careful selection is carried on with native varieties only. At the same time we would strongly recommend that further experiments should be made with American, Egyptian, Brazilian, and other varieties, as it is quite possible that in some parts of India foreign varieties may prove more successful than the native ones.

7. This Association is informed that the methods of cultivation in India are extremely primitive and that if it were possible to induce the natives to adopt more modern methods they would reap the benefit in a larger production of higher grade cotton. There is no doubt that cotton is a plant which readily responds to high cultivation, a fact which is fully recognised by the Governments of the United States and Egypt, who spend large sums on their Agricultural Departments, with the object of helping and instructing the native cultivator.

8. We fully recognise the great difficulty there must be in persuading the Indian cultivator to make any change in his method of cultivation, and we are convinced that the one and only body who can do anything in this matter is the Government of India. We would therefore respectfully suggest that your Lordship would cause enquiries to be made as to the methods pursued by the Governments of those countries, and as to how far they are adaptable to the conditions prevalent in India. We ourselves have a high opinion of

the industry and capability of the agricultural population of India, and we believe that it is possible for them to attain as good results from their farms as is obtained by the inhabitants of Egypt and the Southern States of America from land which is in no way superior to that in India.

9. We are further convinced that the establishment of seed farms as suggested above would afford from an educational point of view most valuable object lessons to the natives in those districts where such farms were established. Further than that, they would afford valuable training grounds for native experts, who could afterwards act as advisers in other districts.

10. No doubt at the commencement these farms might be a considerable expense, but ultimately they would be more or less self-supporting, as the cotton produced on them should cover the cost of cultivation and supervision.

11. We would also recommend for your Lordship's careful consideration the establishment of a special Agricultural Department devoted solely to cotton, and skilled experts should be engaged who are thoroughly acquainted with all the details of cultivation and the best modern systems pursued in the United States and Egypt, where cotton is cultivated on the most scientific methods. We would suggest that in addition to the Central Institution, there should be an efficient staff in each province whose whole time should be given to cotton growing. Their duties should be to supervise and assist as far as possible in regard to the following matters:—

1. Selection of seed.
2. The methods of cultivation, including the use of manures and fertilisers.
3. The ginning and grading of cotton, taking special care that different varieties of cotton are ginned and baled separately and not mixed together as at present.

There is no doubt that success in cotton growing in the above-mentioned countries is not due to superiority of soil and climate, but to the superior supervision given by the Agricultural Departments.

12. We would also suggest for your Lordship's consideration the possibility of some form of financial assistance to the native cultivators on the security of their crops, as in Egypt and the United States, and as in the case with Indigo and Tea Planters in India, so as to ensure that a reasonable interest is charged and that better profits accrue to the farmers than hitherto. Were the same facilities provided in India as are in Egypt and the United States, we are convinced that greater quantities and better cotton can be produced in India than is the case at present. Variable as the climatic conditions are in India they are at any rate no worse than those prevailing in the United States, where an early frost may cut down the crop by half a million or a million bales.

13. We would also recommend that a proper survey should be made of the varieties now existent in India with a view to the selection of that most suited to each particular district. It would also be advisable to collect and supply full statistics as to the area planted, more completely and correctly than is done at present. Further, it would be of great advantage if reports, embracing all provinces, were issued monthly as to the condition of the crop, as is done by the United States Agricultural Department.

14. No doubt the adoption of these suggestions must entail considerable outlay, but we have no hesitation in recommending them for your Lordship's consideration, as the result attained will fully justify the expense. We would point out that should the adoption of these suggestions result in an improvement of quality of only 10 per cent. (apart from the probability of an increased quantity being produced from the same acreage as is now under cultivation), the native cultivators will be to that extent more prosperous, and their increased prosperity will not only benefit India, but will react throughout every part of the British Empire which is commercially interested in our Eastern Possessions.

15. We must also draw your Lordship's attention to the fact that the conditions are entirely different from those prevalent during the cotton famine of forty years ago, and that the present shortage is a permanent one as apparently the limit of production in the United States has been reached and we cannot hope for any large immediate increase in supplies from North America.

Further, that country with its rapidly increasing population will each year require more and more cotton for its own needs. Other countries are also requiring more cotton and there is little doubt that the demand has already overtaken the supply of raw material. It is therefore absolutely necessary that further sources of supply should be opened up with as little delay as possible, and we believe that relief from the present scarcity can be more immediately obtained in India than in any other part of the world. We are quite convinced that India with its one hundred and ninety million agriculturists and its vast variety of soil and climate, has a great opportunity of reaping an enormous advantage in cultivating cotton, and disposing of the same at the high prices which will probably be maintained for many years to come, in fact until supply has once more overtaken demand. The labour, land, transit, and other facilities seem to be all present, and it only requires a good strong guiding hand initiated and maintained by Government.

16. As an instance of what can be done we beg to inform your Lordship that in the first eight months of this year, Lancashire spinners have used 102,000 bales of East India cotton as compared with 8,000 bales during the corresponding period in the year 1900. Nor was this due to the fact that Lancashire was unable to find any other cotton suitable for her needs, but it was because the Surtee Broach produced this year has been the best cotton of that class grown for many years, and has proved most suitable for mixing with American cotton.

17. As a good deal of misunderstanding is prevalent as to the use Lancashire can make of Indian cotton, we must impress on your Lordship the fact that if the quality of cotton produced in India is brought back to the old standard, it would find a ready market in this country. It is quite a mistake to imagine that the machinery in this country is not adapted to spinning Indian cotton. The bulk of cotton used in Lancashire does not exceed 1 inch to $1\frac{1}{8}$ inch in length of staple, and there is little doubt that, provided proper methods are adopted, India could produce large quantities of such cotton, so that her farmers would have the markets of the world open to them, instead of being largely confined as they are now to those countries which use only a very short staple cotton.

18. We are aware that some misunderstanding has arisen in certain quarters as to our motive in endeavouring to improve the quality of cotton grown in India. We must state quite clearly that we have no wish to deprive the Indian, German, or Japanese spinner of his cotton. If there were a large increase in India's production and if of that large increase not one bale was of suitable quality for use in this country, we should still benefit by it, as it would relieve the demand on other and better cottons to our advantage. Our object is to encourage the growth of cotton wherever possible; the ultimate destination of the cotton grown will depend on the price that the buyer can afford to pay for it. If the German or Indian spinner can afford to pay more than the Lancashire spinner, the cotton will go to them. If the Lancashire spinner can afford to pay the higher price the cotton will come to him. The German, Japanese, or Indian spinner is just as much interested in the question of larger supplies as the Lancashire and American spinner. If there is any shortage in supply all must suffer alike, nor does proximity to the cotton fields give any permanent advantage, as is proved by the fact that the mills in the Southern States of America have suffered most severely during the last twelve months. The one fact that we would impress on your Lordship is that if the native cultivator by improving the quality of his cotton can thereby render the same of usable quality for the Lancashire spinner, he will certainly command a larger market than he does at present and obtain a higher price. This question of cotton supply is an international one and must be looked at from a broad point of view, and as a matter of fact the Lancashire spinner is indifferent where the increased supply comes from or goes to, so long as there is enough cotton grown to enable the mills of the world to be fully employed. At the same time we would prefer that the British Colonies and Dependencies should participate in the profits which are ensured to cotton cultivators for many years to come.

19. We can assure your Lordship that the objects of this Association are absolutely unselfish and broad-minded, which is proved by the fact that we are laying out vast sums and are prepared to do so without taking any profits to

ourselves for seven years; as is stipulated in the Royal Charter, which His Majesty the King has graciously granted us. If the Government of India will meet us in the matter, and are prepared to take up the question actively and to co-operate with us, then the same help we are extending to East and West Africa, to the West Indies and elsewhere, will be willingly given by us to India with far more prospects of immediate success than we can possibly hope for from any other part of the British Empire.

20. We therefore most respectfully submit the above for your Lordship's most careful consideration, and we are convinced that should your Lordship see your way to adopt our suggestions it will result in a large increase in the prosperity not only of India and Lancashire, but of every part of the British Empire, and will also benefit the cotton trade of the whole world.

RESOLVED that the following reply be sent to the Government of India:—

From—F. G. SLY, Esq., I.C.S., President of the Board of Agriculture, dated Pusa, the 10th January 1905.

With reference to letter No. 1726, dated 30th December 1904, from the Government of India, I have the honour to state that the memorial from the British Cotton Growing Association was placed before the Board of Agriculture, and I am requested by the Board to forward to the Government of India the accompanying memoranda on the points which have been referred for report.

2. The Board desire at the outset to place on record their cordial sympathy with the aims of the Association and their appreciation of the disinterested efforts which have been made by the Association towards the most important object of the promotion of cotton growing in the British Empire. The Board recognise that these aims and efforts deserve all the assistance and encouragement that it is in the power of Government to give.

3. Before proceeding, however, to a detailed review of the points put forward and the recommendations made by the Association, they consider that it will be useful to summarise briefly the existing position of the Agricultural Departments in India with a special reference to the cotton question.

4. At various periods in the last century, agricultural experiments have been conducted, in some cases by staffs of experts specially introduced from America and elsewhere. Such experiments, which were mostly confined to the introduction of exotic varieties, have resulted with a single exception in failures. Some thirty years ago cotton experiments were accordingly abandoned, and it is only within the last twenty years that any agricultural staff has been again entertained by Government. This staff was until five years ago limited to three or four special officers. Since then the number of such officers has been increased until there are now seven officers on the Imperial staff and seven employed by Provincial Governments.

5. The cultivation of cotton began to receive special attention in 1900, in which year also it is understood that similar attention was for the first time given by the State Department to this crop in Egypt and the work in the United States was expanded. Since 1900 constant and increasing attention has been given to this subject in almost every Province and in particular in the Presidency of Bombay, which contains the most important cotton growing tracts of India. Careful investigation of the cultivation of cotton has disclosed the great complexity of the conditions which affect the crop and the difficulty of attaining any immediate success in the improvement of its staple. The Board do not doubt that the systematic action now being taken by the Agricultural Departments will have an important effect in the improvement of cotton but consider that such improvement must be slow, and they cannot endorse the view of the Association that the superiority of the cotton of Egypt and the United States is due to the work of the Agricultural Departments there and not to conditions of soil and climate.

6. There are very numerous varieties of cotton in the Indian Empire spinning yarns varying from under 10's to over 40's, and as the Association point out, it is necessary in the first place to ascertain definitely which cottons are suited for cultivation in the several tracts. It is possible that in some tracts the substitution of better varieties of cotton may be successfully effected,

In others the improvement of the indigenous varieties can only result from hybridization and selection of seed. The Board are of opinion that the improvement of Indian cotton has not yet reached the stage at which any improved variety can confidently be recommended for general cultivation and until such varieties have been tested with success on Government Experimental Farms, it appears to the Board premature to proceed further than to collect and distribute to cultivators superior seed of the existing indigenous varieties.

7. The measures, which have been and are being taken, are set forth in detail in the reports which have been furnished from each Province in the appendix to this letter. The Board consider that these reports show the urgent need of strengthening the Provincial Departments of Agriculture by the appointment of specialists and subordinates on a scale adequate to deal fully with this important question. In view of the intimate connection of the cultivation of cotton with the whole agricultural economy of the country, it is undesirable in the opinion of the Board that the expert staff so entertained should be dis-associated from general agricultural work. A separation of the cotton staff from the Agricultural Departments would, in the opinion of the Board, be prejudicial to the success of their work. For these reasons the Board are unable to agree in the proposal of the Association for the creation of a separate Cotton Department, but in order to co-ordinate the cotton work throughout India they recommend that there should be appointed to the staff of the Inspector General of Agriculture an officer who has had ample experience of cotton cultivation either in the United States or Egypt. These measures will, if approved, have the most far-reaching influence, not only on the improvement of cotton, but also on the solution of the numerous other important agricultural problems.

8. On a detailed review of the memorial the Board desire to offer the following remarks. There is little evidence to show that the quality of any specific variety of cotton has actually deteriorated. In regard to the special case of the Surat and Broach varieties, the assertion is denied by some of the most experienced native merchants of Bombay, and the fact noted by the Association, that the Surati Broach cotton of the last year was the best cotton of that class that has been grown for many years, confirms the opinion of the Board that such variations are due to seasonal differences. What is often regarded as deterioration of staple is in fact the substitution of hardier varieties with inferior lint, which are on the average more profitable to the cultivator. It is possible also that the deterioration apparent in some cottons exported to England is due to intentional admixture by the trade. It is also reported to the Board that in parts of Madras the mixture of early and late varieties is deliberately grown by the cultivator as a safeguard against the fluctuations of seasons.

9. In regard to the distribution of selected seed, the Board are of opinion that the most satisfactory course would be to await the result of the experiments which have recently been undertaken on the Experimental Farms. At present no Provincial Department is in a position to recommend confidently any improved seed to the cultivators for adoption on a commercial scale. The method of the operations in progress is described in detail in the note of the Deputy Director for the Bombay Presidency. In many tracts, however, advantage will result from the collection of seed grown by native cultivators, which can be purchased from their fields and distributed by Government agency, and measures to this effect are in progress. It may be noted, however, that the evils resulting from the public ginneries should not be over-stated. Cultivators of the best varieties of cotton frequently reserve for their own sowing a portion of the crop which they hand-gin at home, and even in the ginneries of some parts of India the admixture takes place in the lint after the seed has been removed. The Board consider, however, that good will result from the co-operation of the owners of ginneries in preventing the mixing of seed.

10. No improvement can yet be recommended in the best cultivation of the best cotton tracts, but it will be observed in the appendix that some Provinces are endeavouring to improve practices where they are defective. The improvement of methods of cultivation is largely an economic question, dependent on the resources and character of the cultivator, which are not susceptible of drastic remedy.

11. As regards financial assistance to cultivators, the Board note that there is already in existence an extensive system of State agricultural loans. It is understood that no such assistance is given in the United States, and the Board are unable to suggest any improvement in the existing Indian system, which has recently received the most careful attention.

12. No efforts are spared to render the collection of statistics and estimates of area and outturn as complete as possible. Information of the agricultural prospects throughout India is published periodically by the several Governments; and it is suggested that existing periodical reports should deal more fully with the cotton crop and that a monthly abstract showing the general condition of it should be published.

13. The Board would beg to point out that the question of the extension of the area under cotton is chiefly a question of profits and prices, and the view set forth by the Association in September that the present shortage of cotton is a permanent one and that the existing high prices will probably be maintained for many years to come, requires qualification in consideration of the recent reports of the large outturn in the United States and the consequent fall of prices.

14. There remains the important recommendation of the Association that Government Seed Farms should be established throughout all districts where cotton is grown, on which continual selection could be made year by year to ensure a supply of the best possible seed to native cultivators. The Board are in accord with this policy. As to the steps which should be taken to give effect to it, they would first remark that having regard to the experience of the past in the selection of indigenous cottons, they consider that improvement will be slow and will probably not be very marked at the start. At the present time in some tracts where the better varieties are grown, the cultivators continuously practise selection of seed. Turning to the short-stapled varieties, attention is given to these likewise by good cultivators. The Board consider that efforts for the improvement of cotton by selection and hybridization should certainly be persevered with and extended. There should be a selection farm of an adequate size in each representative cotton tract, if such is not already in existence, and this farm, in view of the interests at stake, should be under the most efficient management and control. The Board do not consider that a large area is required for the effectual selection of suitable types of any particular variety. The great need is at present for men. In places where existing farms do not provide sufficient land for these selection experiments, the necessary arrangements should be made.

15. At the present moment there is no improved variety which the Board can recommend for distribution. A great deal of preliminary work must be done, and this should be undertaken without delay. When an improvement has resulted from selection or hybridization, the Board agrees that every endeavour should be made to distribute it and to maintain or enhance its excellence. The means which have been approved for this purpose include:—(*a*) the establishment of demonstration plots; (*b*) utilisation of the agency of large landowners, District Board Associations and Courts of Wards Estates; and (*c*) publication of information. In short, the value of the variety can be demonstrated practically, seed can be issued in an appreciable quantity, and the cultivator can properly be left to judge for himself whether the improved or new variety is one which it will pay him to take up. This method has proved satisfactory with other crops in the past, but for cotton in particular it is essential that the seed of any improved variety should be put out on a large scale so that the cultivator may get the benefit of the real value of the improved staple.

16. A proposal was made to the Board that seed farms of 5,000 acres should be established in each Province for the selection and distribution of good seed. From the point of view of selection, the Board consider that it can be carried on as effectually on a smaller area, indeed more effectually as regards supervision. From the point of view of quantity of seed for distribution, the Board cannot express any opinion as to the exact size of the farm which should be established in each particular case. In considering this important question, the Board desire to point out that the memorial was submitted to them after their deliberations had commenced and that they had

no carefully matured scheme preliminary to the discussion. They would, therefore, prefer not to put forward any such scheme, but as the Government of India desire to ascertain their definite views, the Board with some hesitation suggest that the following proposal should be submitted to the Provincial Governments concerned for their consideration. Substantial farms (say 1,000 acres, of which half would be available annually in rotation for cotton) should be established for the following purposes :—

(*a*) One farm in the Surat-Broach cotton tract of Bombay for the improvement of the indigenous variety by selection of seed and its distribution.

(*b*) One farm in a suitable irrigated tract of the Punjab for the trial of exotics and for seed distribution.

(*c*) One farm in the Central Provinces for the dual purpose of (1) the improvement of the coarse *jari* variety by continuous seed selection and distribution, and (2) the improvement of the fine *bani* variety by seed selection mainly to improve the yield, and seed distribution.

17. Great importance is attached by the Board to the co-operation of the Irrigation Department, both in furnishing water for the cultivation of irrigated cotton at the most suitable season, and at regular intervals; and also in the settlement of favourable rates thereon. There is some hope of the increased production of superior varieties of cotton under irrigation, especially in the United Provinces, the Punjab and Sind. If this hope is fulfilled, the extension of perennial irrigation in Sind would deserve the most careful consideration. The improvement of railway communication would also seem to be of importance to the extension of the cultivation of cotton in tracts in which such cultivation is now limited owing to the difficulties of transport.

16. Finally the Board have carefully considered the Association's generous offer of financial assistance, but since the Board are not possessed of administrative functions they do not feel that they are entitled to comment on the subject.

FOURTH DAY.

Publications.

43. The subject of publications was considered by the Board. Mr. Moreland's letter on the question of the utility of Experimental Farm reports was read. Dr. Leather mentioned certain disadvantages of the reports as at present issued and recommended publication in octavo form and a less official style. He considered that a separate report on the administrative work might with advantage be published, apart from the record of experimental work.

The Board suggest that separate bulletins should be issued by the Provincial Departments of Agriculture dealing with detailed experiments when they become sufficiently advanced to yield definite results; that an annual administrative review of the working of an experimental farm should be issued either as a separate publication or as a part of the Director's annual report and that a separate annual report of the experimental work should be issued in octavo form for distribution only to persons interested therein.

44. The Board consider that it is desirable to publish an Agricultural Journal for the information of the agriculturist and the general reader interested in agriculture. With regard to the form of the journal it is considered that it should be printed wherever the most satisfactory arrangements can be made and should be of the highest quality obtainable as far as general get up and specially that the illustrations should be the best that can be procured. It should issue, quarterly at first, from Pusa, and be edited by a committee of the Pusa staff. There should be a free distribution list but the issue free to individuals should be carefully controlled. A review of current literature dealing with agricultural topics would add to the value of the publication. As regards the Agricultural Ledger, it was generally felt that it did not fulfil the requirements of an Agricultural Journal of use to the agricultural community. It was of too heterogenous a description, containing papers relating to very diverse subjects often of interest to the scientist rather than the general reader and

many of which were not agricultural at all; it was not well got up, was not of topical interest and it failed to reach those for whom it would be of use.

45. It was agreed that the Journal cannot with advantage contain papers of a scientific or technical nature. For the issue of these it is recommended that separate Scientific Memoirs should be started. This should appear as material became available from the scientific staff at Pusa and from other workers. The recommendations for the publishing and editing given above would apply in this case also Papers which were unsuited for issue at Pusa, or which might with advantage be published elsewhere, would be subject to the usual Government rules. To these general recommendations Mr. Pedler, Captain Gage, Dr. Lehmann, Mr. Mann and several other scientific members of the Board give their approval.

Measures to bring the Imperial Experts into closer touch with Provincial Departments of Agriculture.

46 With regard to the important question of inter-communication between Imperial and Provincial experts and between the latter, the Board consider that in the interests of agriculture it should be made as free and unfettered as possible. No definite rules can be laid down, but the Board suggest that actual proposals which affect the working of the Department, such as the starting of new investigations, the introduction or alteration of farm experiments and the like, should be the subject of official correspondence addressed to the Director. All other matters of detail connected with lines of work already sanctioned should be dealt with direct between the experts concerned who must keep their Heads of Department fully informed of all the work being done. Specimens for examination should be sent direct to the officer concerned, the fact being reported to the Director. They also suggest that Imperial experts should report to Provincial Directors the general results of a tour as soon as it is completed, it being recognized that such reports may on occasion be for the information of the Provincial Department only.

47 The training of Provincial Assistants to assist the Imperial experts in special branches of work such as Entomology is recognized by the Board as being of great practical utility. In the subjects of Agricultural Chemistry and Cryptogamic Botany, such assistance is of lesser importance and more difficult of attainment.

48. The Board consider that suitable rest-houses both for Europeans and Natives of India might with advantage be provided at Experimental Farms where there is definite need of them.

49. It is the advice of the Board that a lending department should be included in the Library arrangements of the Pusa Institute, for the benefit of workers who may wish to consult the literature of the subject in which they are interested.

Measures to bring the Provincial Departments into closer touch with Agriculturists.

50. The Board is of opinion that an extended use of leaflets on agricultural subjects is generally desirable. It is felt that such leaflets to be successful in reaching their object should be brief, perhaps not exceeding a couple of pages, and should contain one definite fact or the description of a single process which it is desirable that the ryot should know or adopt. With regard to vernacular Agricultural Magazines, it is recognized that in many localities these are of distinct utility. In others their place may be taken by the employment of the vernacular press. Each Province must determine according to the local conditions which of these channels will most readily reach the cultivator. Frequent communiqués to the vernacular and English press are recognized as most useful.

51. The formation of District Agricultural Associations is recognized as having proved useful in the Central Provinces. In some other Provinces there appears to be an indication that a considerable measure of good will result from similar societies. In any case the success or failure of these

Association depends, to a great extent, on the co-operation of the right class of men.

52. The establishment by the Provincial Agricultural Departments of Demonstration Farms or plots is recognized as being a most valuable means of bringing home to the cultivator improved methods of cultivation or the advantages of improved varieties of crops. No definite opinion is expressed regarding the nature or management of these plots, which it is felt must depend largely on local conditions. Local hearty co-operation is considered essential to their success.

53. It is considered that Experimental Farms are not always the best places for holding agricultural classes and for the training in practical farming of agriculturists, since the conditions enforced by the experimental nature of the work are often of such a nature as to render the practices at such farms inapplicable in ordinary cultivation. Demonstration Farms are however particularly suitable for such classes.

54. Agricultural shows are considered to afford a useful means of disseminating information of value to cultivators, in particular where improved implements or practices can be exhibited or superior samples of produce displayed. For this purpose a permanent itinerary nucleus is recognized as a valuable adjunct.

55. The agency of Court of Wards Estates can be usefully employed, where suitable men are available on the Estates and where action is restricted to practices which are consistent with recognized high farming as distinct from purely experimental work.

56. The Board were informed that in some parts of India more good was obtained from interesting and working with small landowners than large proprietors. Local conditions must, however, be considered in judging to what extent any particular class of agriculturists is likely to be of assistance.

57. The Board is of opinion that every effort should be made to induce cultivators to visits Experimental and Demonstration Farms.

58. It is recognized by the Board that the plan of seed distribution adopted in the United Provinces has been a definite success and has resulted, in addition to its immediate advantages, in bringing the Department of Agriculture into close touch with local cultivators in the areas in which the seed has been distributed.

Agricultural Education.

59. The question of Agricultural Education was considered by the Board, upon which subject Mr. Pedler, Director of Public Instruction, Bengal, addressed the meeting. The Board desire to place on record their opinion that it is of the greatest importance that full effect should be given to the policy laid down in paragraph 21 of the Resolution on Indian Educational Policy issued by the Governor General in Council in March 1904, in regard to the principles of education in rural schools, for with that policy is bound up the future of Indian agriculture.

60. Mr. Pedler enquired what provision could be made at Pusa for providing trained instructors to teach in training schools the right methods of imparting these principles of education. The Board consider that as Pusa is primarily a Research Institute, the present scheme does not admit of teaching a large number of such masters. The requirements of Bengal in so far as the training of masters for the higher grade training schools (which are few in number) can probably be met at Pusa. They have no remarks to offer with regard to the training generally of the lower grade training school masters and of the masters of village schools.

61. In regard to the training of Farm Overseers, Mr. Coventry reported that he could take a limited number of men at Pusa. In view of the urgent need of trained Overseers, it was considered that each Province should utilise to the utmost any facilities for such training in their Experimental Farms.

FIFTH DAY.

Purchase of Scientific Apparatus and Stores.

Mr. Moreland brought up for the Board's consideration the Govern- 62.
ment rules regarding the purchase of European stores by Government officers and offered some suggestions for their modification in the case of the Scientific Officers of the several Agricultural Departments in India. He pointed out the inconveniences attendant on delay in obtaining instruments, chemicals and other materials required by these officers and mentioned that indents supplied by him were received after delays as follows :—indent of 21st July 1902, completed by 9th June 1903; indent of 1st June 1903, received by 9th February 1904; Indent of 20th June 1904, not yet received. In several cases the materials received had to be returned. On the other hand, an indent made direct to the manufacturers with the permission of Government on 2nd July 1903 was received on the 6th October 1903. As the result of these delays it became necessary to maintain an excess of stock over what was actually required. Where material was not ordered direct from the manufacturer the danger of getting an article differing from that ordered was increased. Dr. Leather mentioned several instances in which indents were completed within 3 or 4 months when dealing direct with manufacturers. Several of the scientific members of the Board endorsed Mr. Moreland's remarks.

The Board consider that scientific officers of the Department of Agriculture might with advantage be permitted to indent direct on the dealers; that the danger of abuse in the case of these officers is slight since scientific material is usually purchased by catalogue, but that if abuse be feared, copies of the indent might where required be furnished for the inspection of the India Office.

APPENDIX A.

The Jute Crop of Bengal.

In order to give some idea of the extent of the jute industry in Bengal, the following figures may be useful:—

The area under jute in 1904 was 2,850,000 acres, of which 750,000 acres are in Mymensingh and 400,000 in Rungpore. The normal yield may be taken at 15 maunds per acre and the price at R5 per maund, so that the annual yield may amount to nearly 1,600,000 (sixteen hundred thousand) tons, and the value to over £14,000,000. The area under jute cultivation has increased by 25 per cent. during the last ten years.

There are practically only two kinds of jute grown, *viz.*:—Corchorus Capsularis and Corchorus Olitorius. C. Capsularis stands water-logging better than C. Olitorius, and so the former is found in the low-lying lands, while the latter grows in the higher lands, especially where the soil is heavy. It is said that the fibre of C. Olitorius is coarser than that of C. Capsularis; but there does not appear to be conclusive evidence on this point.

Practically the whole of the land under jute in Bengal is alluvial, being part of the Indo-Gangetic plain. Some of the lands are high, *e.g.*, in Mymensingh, and some are low, *e.g.*, in Serajgunj. The lower lands are inundated annually during the rainy season by the rivers Ganges and Brahmaputra, up to a depth of 5 feet or more. They thus receive a yearly deposit of silt, which must tend to keep the soil in a fertile condition.

The rainfall is heavy over the whole of the jute-growing area, being from 60—70 in. per annum, and during the growing season, *viz.*, from April to August, the temperature is high, a hot moist atmosphere being the result.

Altogether there are considerable differences in the textures of the soils upon which jute is grown, some being moderately coarse sand and others exceedingly fine silt: yet, there is no land in the jute districts of a gravelly or rocky nature. The general opinion, based on observation, is that the best jute is obtained from the heavier soils and that the fibre produced on sandy land is apt to become coarse and stunted.

I have not visited either Madras, Bombay or Burma, and so I cannot say whether or not jute cultivation would be likely to be successful in these places.

The present research work was started in consequence of complaints of the deterioration of jute fibre during recent years; and five possible causes of deterioration have been put forward, *viz.*:—

1. The almost universal practice of wetting the fibre and adding sand to increase its weight before bringing it into the market.
2. The lands growing jute are becoming exhausted owing to insufficient manuring and lack of application of the principle of rotation of crops.
3. Lands not suited to the growth of jute and producing inferior fibre have been brought into cultivation.
4. Scarcity of water suitable for retting purposes.
5. Want of care in seed selection, methods of sowing, etc.

The first four of these possible causes indicate roughly the lines on which it is proposed to conduct a scientific enquiry into the question of deterioration. The fifth cause must, of course, be left for the experimental farms to investigate.

With regard to cause (1), a Bill to prevent fraudulent adulteration of jute is now under the consideration of the Bengal Chamber of Commerce. I have estimated the moisture in a number of samples of wet and dry jute, some at least of which have been found to contain over 50 per cent. of water. Good dry samples on the other hand have been found to contain only 10—13 per cent. of water under the same atmospheric conditions. Of course, at this time of year (January) the moisture absorbed from the air is less than from the almost saturated atmosphere of the rainy season; but it is not probable that, even with a saturated atmosphere at 90°F., the amount of moisture

absorbed by a sample of jute would ever be much more than 20 per cent. Experiments will be made to determine accurately the maximum amount of moisture which a sample of jute is capable of absorbing from a saturated atmosphere at a high temperature.

With regard to the question of exhaustion of lands, it is hoped that a series of physical and chemical analyses of jute-growing soils will give some definite evidence. If it is a fact that some lands are becoming exhausted, they must either be manured, or the land must be renovated by rotation. Manuring is expensive, and it is doubtful if, owing to the low price of jute, it would be profitable to apply mineral manures in sufficient quantity. Rotation of crops would tend to reduce the average output, and thus, in order to keep up the supply, new areas would have to be brought into cultivation.

The retting process is a very large question, but bacteriological experiments indicate the possibility of reducing the time of steeping very considerably by the use of dilute salt solutions containing phosphate and ammonia. If the fibre produced by hastening the retting in this way is sufficiently superior to that obtained by the ordinary process to pay for the extra cost of its production, then, of course, it would be profitable to produce the superior fibre on a commercial scale. Owing, however, to the relatively small differences between the prices of good and inferior jute, it is difficult to make a definite statement on this point until further experiments have been completed.

Some work has to be done on the manurial value of the silt annually deposited by the rivers on low-lying jute lands, and a great deal of work has also to be done in comparing the chemical and physical properties of fibres from different districts and from different varieties of plants.

The experiments above suggested require the continuous work of a whole-time chemist extending over several years.

ROBERT J. FINLOW,

Special Jute Expert to the Bengal Government.

APPENDIX B.

Notes on the extension and improvement of Indian Cotton.

Bombay.

The Bombay Presidency, including Native States, has some five million acres under cotton and produces approximately one million bales or one-third of the total outturn of India. The cotton areas fall into five sub-divisions:—(1) Surat and Broach; (2) Dharwar, and the Southern Maratha Country; (3) Khandesh; (4) Gujarat and Kathiawar; and (5) Sind.

2. This is the fifth season in which cotton experiments are in progress in the Bombay Presidency. They were begun in 1900 on the Poona Farms by Mr. Mollison for the purposes of conducting hybridization and botanical investigation under the charge of the Professor of Botany at Poona. Poona not being situated in a cotton tract, the work was transferred two years after to the Surat Farm and is there extensively carried on under the charge of Mr. Fletcher, the Deputy Director of Agriculture.

3. In 1903 a new farm was started at Dharwar for the investigation of the cotton of that tract and has been cultivated in the current season 1904. At the same time cotton experiments were commenced in Sind with a view to the introduction of Egyptian and American varieties, and the first year's experiments have been remarkably successful. A farm is now being established on the Jamrao Canal in Sind. In regard to Khandesh, experiments have been carried on locally for two years on plots of land temporarily leased, and proposals are now before Government for the establishment of a permanent farm in that area. In regard to Gujarat, experiments have been made on small plots in the Ahmedabad District which are being continued and have been commenced on the new farm which has been established at Nariad in the Kaira District since 1903. Thus each separate cotton tract of the Bombay Presidency is now being served by a separate farm on which special attention is being given to the improvement of cotton. The Deputy Director, Mr. Fletcher, supplies the following account of the operations which are in progress.

H. S. LAWRENCE,
Director of Land Records and Agriculture,
Bombay.

The chief cotton-growing areas in the Bombay Presidency are:—(1) The Ahmedabad District; (2) the Surat and Broach districts; (3) Khandesh; (4) the Ahmednagar and Sholapur districts; and (5) the Southern Maratha Country.

In the Ahmedabad District there are three varieties of cotton grown, *viz.*, Rozi, Wagad and Lalio. The former is perennial and the latter two are grown as pure crops in separate tracts, accidental mixture occurring only where these tracts adjoin. In the Surat and Broach districts the principal variety is the Surtee-Broach, Goghari being grown in a few villages only. In Khandesh the variety of the same name is grown, while in the Ahmednagar and Sholapur districts this variety is put on the market under the name of Barsee, etc. In the Southern Maratha Country two varieties are grown, *viz.*, Kumpta and Dharwar American. There is little admixture except where the tracts growing the two varieties adjoin.

The work of improving these varieties is proceeding along the following five lines:—

(*a*) Selection of individual plants, some for quality of fibre, others for largeness of yield, from the cotton crops on the farms.
(*b*) Crossing of one indigenous variety with itself or with a second indigenous variety.
(*c*) Crossing of indigenous varieties with exotics.
(*d*) Introduction of exotic varieties to be grown as field crops.
(*e*) Distribution of sound and pure seed to cultivators.

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(*a*) *Selection of individual plants.*—This has been necessarily confined until the present season to the Surtee-Broach variety, since only in the district growing this variety has a cotton-growing farm been hitherto available. Owing to a succession of bad seasons no marked advance has been made, but a more vigorous method is now being used, and given average seasons, definite improvement must follow. This selection in the current season has been extended to all the cotton-growing Government farms in the Presidency and will be continued. As soon as an increased staff is available, the process of selection will be extended to the fields of cultivators with a view to obtaining more rapidly a workable quantity of seed of an improved type.

(*b*) *Crossing of indigenous varieties inter se*
(*c*) *Ditto ditto ditto with exotics.* } These lines of work were commenced in 1901. Last season a very rigorous selection of the hybrids so far obtained was for the first time made and this was done from two points of view, *viz.* :—(1) improvement of the quality of the fibre. (2) improvement of the largeness of yield. With regard to the former, several of the many hundreds of crosses intended for growth in the Surat District shewed an improvement of 10 per cent. over the local variety; with regard to the latter, a cross between the two local varieties of the Dharwar District (Kumpta and Dharwar American) has shown this season a marked superiority over both parents. These types require "fixing," a process that will take two or three years further selection.

(*d*) *Introduction of exotic cottons.*—During the past season American varieties have been grown from freshly imported seed on the Dharwar Farm and American and Egyptian varieties on the Dhoro Naro (Sind) Farm. Both give promise of valuable results, one of the Egyptian varieties on the Dhoro Naro farm having yielded about 500 lbs. of ginned fibre per acre over an unmanured area of between three and four acres. The Egyptian plants on this farm have been carefully watched throughout the period of their growth, and the course of their development corresponds exactly with that of the same varieties when grown in Egypt. This is a very promising feature and justifies the expectation that if deterioration occurs at all, its course will not be rapid. It is not proposed to introduce exotics into parts of the Presidency other than the Dharwar district and the perennially irrigated tracts of Sind, since in these districts alone does the water supply, in the one case from rainfall and in the other from irrigation canals, extend over a sufficiently long period of the year for the growth of long-stapled annual varieties.

(*e*) *Distribution of sound seed to cultivators.*—In accordance with the orders of the Government of India arrangements have been made to secure and distribute pure seed of four of the seven principal varieties grown in the Presidency, *viz* :—

(i) Dharwar American	Dharwar District.
(ii) Kumpta	
(iii) Lalio	Ahmedabad District.
(iv) Wagad	

In the case of the Surtee-Broach, Goghari and Khandesh varieties, no action has been taken, because as far as is known the two former varieties are grown as pure crops in their respective districts, while the last named (Khandesh) variety is probably incapable of improvement by this method.

F. FLETCHER,
Deputy Director of Agriculture, Bombay.

United Provinces.

(*a*) *Botanical examination and classification of existing varieties.*—Specimens of all known varieties have recently been supplied to the Inspector General of Agriculture at his request; and it is understood that they are being classified under his orders.

(*b*) *Provision of good seed of the varieties ordinarily grown.*—Individual selection carried out over a prolonged period, combined with expensive cultivation, has given a slightly better cotton than what is grown in the country round Cawnpore; the apparent improvement is due, in all probability, mainly to the careful methods of cultivation and quality of the land which we have used, and there is no prospect of its maintenence in the soils ordinarily devoted to the crop. If then this result only has been obtained by individual selection, there is in these provinces no prospect of material improvement from the imperfect and generalised methods of selection recommended by the Government of India, which are suitable only where the cotton is fairly good to start with. These methods of selection are, however, being followed with the idea that possibly further deterioration may be prevented in the tracts where the selected seed is distributed.

(*c*) *Introduction of better varieties and improved methods of cultivation.*—American cotton, acclimatized at Cawnpore during the last ten to fifteen years, though not so good as in the country of its origin, has under good cultivation retained much of its character and length of staple, which has not shown any sign of progressive deterioration for some years past. A few cultivators about Cawnpore are taking an interest in this variety and will give it a trial if prices remain at their recent level; and we have sufficient experience to justify us in distributing it in our own neighbourhood, but not elsewhere. The question whether cultivators will attempt to cope with the insect pests which this cotton undoubtedly attracts can be determined only by experience. Very many varieties of cotton, including Indian, American and Egyptian, have been tried in the past and found unsuitable to our conditions, or at least have shown themselves much less suitable than the acclimatized variety referred to above. We are prepared to try during the next season any varieties that are suggested, which have not already been discarded on sufficient grounds; but we are ourselves unable to suggest any fresh varieties for trial. Hybridization with the American varieties growing on the farm has uniformly failed to produce any effect; the Economic Botanist will endeavour to produce hybrids with any varieties where there appears to be a chance of success. The methods of cultivation recommended by the Inspector General are under trial.

W. H. MORELAND,
Director of Land Records and Agriculture,
United Provinces.

Bengal.

(*a*) *Botanical examination and classification.*—Nothing has been done in Bengal regarding the botanical examination and classification of existing varieties. This work is in the hands of the Inspector General of Agriculture.

(*b*) *Improved varieties and improved methods of cultivation.*—Last year the Inspector General of Agriculture sent small quantities of Egyptian and American varieties for experiment on the farms. The seed was sown at Dumraon and Sripur Farms by a drill under the supervision of a Gujarati cultivator. Seed was also distributed by the Inspector General of Agriculture to planters in Behar. The experiment is not likely to be a success because the sowing was very late (in May and June) and untimely rainfall damaged the crop especially at Dumraon. The experiments will be continued on a small scale in the Government Farms and it is understood that they will be continued by the Behar planters. No experiments have been made in the way of seed selection or of hybridization owing to want of expert direction.

Generally speaking, in Bengal, cotton is not a *field* crop; it is grown for the most part in homesteads and as a mixed crop together with *arhar* (pigeon pea) and castor. It is necessary, therefore, for the Department to determine whether it can be successfully grown as a field crop before inducing cultivators to grow it as such. This suggestion is in accordance with the views of the Board expressed in its first resolution on this subject.

(*c*) *Provision of good seed of the varieties ordinarily grown.*—At a Meeting of the Provincial Agricultural Association this question was considered. It was resolved to start seed selection in a small way and to repeat the experi-

ments at the same centres for several years. Government has accordingly sanctioned four centres for work on the collection and selection of seed of the best indigenous varieties. The centres selected are Maniarpur (Durbhanga), Sripur (Saran), Cuttack and Purulia (Manbhum). The best local varieties are found within reach of these centres.

Maniarpur.—The experiment, the cost of which is to be borne by Government, is being undertaken by Messrs. Shaw, Wallace & Co. It is proposed to select the growing plants in the field from which seed will be reserved. Plants will be selected for such qualities, *e.g.*, length of staple or prolific yields, as the Board may advise. The ginning will be done by hand and only seed of the best specimens retained. A history of the crop, conditions of the season and the like will be kept for each variety. Next year it is proposed to distribute this seed to cultivators of the same locality on condition of return from the crop they grow of the same quantity of seed plus 25 per cent. It is proposed to repeat this experiment for several years until the superiority of the local types is assured. It is then proposed to open seed godowns and to sell selected seeds *at cost rates.*

In the other centres (but on a much smaller scale) similar experiments will be conducted under the control of the Superintendents of the Cuttack and Sripur Farms, and in the case of Manbhum by an Overseer of the Department.

It is proposed to collect seed also of tree cottons in order to conduct some experiments in the Dacca District and to provide for indents for tree cotton seed from other provinces.

Letters have been addressed to the principal mill-owners in Bengal with reference to the ginning without discrimination of all cottons sent to their mills. One or two have promised to set apart specially fine lots to be separately ginned with a view to avoiding damage to the seed and to making a report to the Department of the history of these cottons. They will also supply samples of the lint and sell seed at cost price plus the cost of separate treatment.

The best local variety known in Bengal is the "*Buri Kapas*" which is said to yield in Manbhum *on homestead lands* 400 lbs. cleaned lint per acre. Special pains will be taken to select seed of this variety both for distribution in Bengal and to other Provinces. The Department is also willing to undertake in its farms experiments on a small scale in any varieties which may be sent to it from other Provinces.

S. L. MADDOX,

Director of Land Records and Agriculture,
Bengal.

Madras.

In Madras there are four separate areas in which distinct varieties of cotton, from a commercial point of view, are produced and in one of these there are three different sorts of cotton grown. Of these areas, that where "Salems" are produced is not at present provided for at all, nor is that where "Cocanadas" are grown. In the former area, there is not only a valuable annual sort grown, but a perennial cotton and also the Bourbon cotton, which is a relic of an introduction of 80 years ago.

In the areas where the two commercial varieties known as Tinnies and Westerns are produced, the work proceeding on the existing experimental farms is the selection of seed from plants true to type and endeavours, by cross-breeding *inter se*, to increase the vigour of the plants. In the case of Tinnies, it is clear that there are two types of cotton commonly grown, and these are uniformly sown mixed because one yields better under rather different seasonal circumstances than the other. The degree of mixture varies, and the first problem is to prove whether separation would be more profitable than mixture. The dealer and manufacturer would prefer separation, but it is not known what inducement he would offer to secure this. In the case of Westerns, the existing bazar seed is greatly mixed, owing largely, I believe, to misdirected efforts to introduce other sorts into the area. The problem is to decide which of the local Javari types of cotton is the most suitable. These vary (1) in colour, (2) staple and texture, and (3) as to seed.

Of the latter there is a clean seeded sort which, from the feeding point of view, is specially valuable. Besides this a second type, found chiefly on the light soils—Yenapatti—is being grown and of this also there is more than one variety as to colour of the lint, and the same question has to be settled. This year's sowings with Westerns are not likely to yield much useful result as the season has been very unfortunate and it may only be possible to secure seed for next year.

As to Tinnies, the prospects of the crop are much better and the experimental crops now growing may go some way to answer the question stated above. Here it is anticipated that a good deal of cross-breeding on the lines mentioned may prove possible, but until I see the crops again I cannot say exactly how far this can be carried out. In both cases and as far as possible, selection of seed will be proceeded with.

As to the question of the general selection of seed during the current season nothing definite has yet been decided on, and as far as certain parts of the Presidency are concerned, the crop will be so bad as to make it practically useless to attempt anything. Little will be possible during the current official year as the picking season is later. My proposals are to concentrate all available hands on the work in different tracts successively and after choosing fields to set them to select as much *kapas* as possible from the best plants, these *kapas* to be carefully examined and sorted and then ginned and the seed sold later on to growers.

C. BENSON,

Deputy Director of Agriculture, Madras.

Burma.

The development or improvement of cotton in Burma has not been attempted on serious scientific lines. Casual experiments have in the past been made with exotic varieties like Sea-Island and Egyptian, but without any great measure of success. During the present year further experiments are being tried, and those from which the most useful results are anticipated are being carried out under careful European supervision in the compound of Messrs. Finlay, Fleming & Co. (the Burma Cotton Company) at Myingyan. Their plot practically meets all the requirements of an experimental farm and more valuable results are anticipated there than from all the haphazard efforts of the past.

There are two main problems with regard to cotton in Burma. The first is increase of area and the second is improvement of staple. The first must be left largely to the natural trend of cultivation, but it is fairly certain that the high cost of labour will always be a serious handicap to development on a large scale.

As regards improvement of staple, measures are being taken to carry out the orders of the Government of India for the selection of seed. In the absence of a separate Agricultural Department, this has been done through the agency of the Deputy Commissioners of the principal cotton-growing districts working through the Land Records Staff; and the grant of Rs. 5,000 has been distributed amongst five districts proportionately to their importance as cotton producers. Owing, however, to the late receipt of the orders on the subject and the fact that in Burma most of the crop is sold to the large ginning mills even before it is picked, no great measure of success is anticipated this year. In fact only two out of the five principal cotton-growing districts addressed in the matter hold out any hope of being able to carry out the scheme. The value of careful selection of seed has, however, been brought before the notice of all the principal mills by circular letters and it is believed that they are now fully alive to the importance of the subject. The healthy stimulus of competition is undoubtedly exercising a beneficial effect on the whole industry.

As regards long staple Pernambuco Tree cotton, an examination of local conditions and an enquiry into the possibility of extended cultivation will be made during the present season. So far the crop has not been grown on any large scale but arrangements have been made for considerable supplies of seed to persons interested in the cultivation in the Tenasserim Division. Experiments are also being carried on by the Burma Cotton Company at Myingyan. On

the results of these experiments which will be closely watched, the Department will be able to decide whether the extension of this crop should be encouraged and to devise a scheme for its systematic development.

J. MACKENNA,

Director of Land Records and Agriculture,

Burma.

Punjab.

1. Punjab cotton is of the low grade known commercially as Bengals. In this connection, the Province divides itself into two well-defined tracts. In the Delhi Division the greater part of the cotton area is unirrigated. The crop is sown with the arrival of the monsoon in about June or July and is about six months on the ground. In the Lahore and Multan Divisions cotton is almost entirely an irrigated crop sown in April and May and maturing in from seven to eight months. In the Jullundur Division, which lies between these two tracts, we find both systems in vogue. A few varieties, as for example, those grown in Hissár, Palwal, Dera Gházi Khan and Lahore, are better than the others, their superiority consisting chiefly in the higher proportion of lint to seed. Peshawar is apparently the only district in Northern India where a fair staple is produced which can spin up to 20's. But the proportion of fibre and the yield per acre are small.

Early efforts to acclimatise exotics in the Punjab.

2. In the past, efforts have been made from time to time to introduce exotics including American, Egyptian, Nankin and Bombay varieties. But, in the total absence of experimental farms, and of an Agricultural Department, except for a Director of Agriculture, it is not surprising that failure has had to be recorded on every occasion. Apart from trials at the Agri-Horticultural Gardens, Lahore, the method adopted was the distribution of seed to cultivators, who, as a rule, took no interest in the matter. These failures, although they raise a presumption against exotics, cannot, in these circumstances, be regarded as conclusive proof that the varieties introduced were unsuitable to the Punjab soil and climate. A point which cannot be insisted on too strongly is that no exotic can be held to have had a fair trial until it has been grown with the care and attention which it is accustomed to. I doubt if any of these varieties ever received the treatment which it required, including sowing in rows or ridges at wide intervals in well prepared soils, manuring, thinning, topping, weeding and frequent watering.

Expansion of cotton cultivation in recent years.

3. In consequence of the favourable prices which have obtained for some years, increased attention has been directed to cotton. The area has almost doubled in the last decade and now exceeds a million acres annually. A further impetus has been given by the establishment of ginning mills in all directions, affording facilities for marketing. But the influence of ginning mills has, in one respect, proved to be directly prejudicial. All pickings, early, middle and late, of good and bad varieties alike, are ginned together. This mixed seed being issued in large quantities to the cultivators, the result is a steady deterioration. The more intelligent cultivators select and gin their own seed cotton, but these, although they are increasing in numbers, are in a minority. Some good practical work has been done in several districts towards the selection and adoption of those indigenous varieties which are the hardiest and most prolific, and which show the highest percentage of lint to seed.

Punjab Narma.

4. The only exotics of which any traces remain in the Province are what are known as *Narma* and *Kháki*. *Narma* is the descendant of the Upland American cotton seed distributed some 20 years ago through this office. It is very rarely grown as a separate crop, but a few plants are to be found in most fields in the Central Punjab. Although the lint has deteriorated, it is still finer, softer and longer than that of the indigenous varieties, and is probably about equal to *Dharwar* cotton which is also an acclimatised American. I believe that *Narma* is occasionally to be found in small plots grown for local consumption—a garment made of it being prized for its softness. No care whatever having

been bestowed on this cotton, the fact that it has survived and holds its own in the field side by side with indigenous cottons leads to the inference that the Punjab climate is not unfavourable.

Nankin or *Kháki* cotton.

5. *Kháki* or "Nankin" cotton has a history somewhat similar to *Narma*. It was imported from China in the hope that it would be of value in the manufacture of *khákí* drill. The fibre when tried was so weak that it was useless for this purpose. But stray plants are still to be found and patches of it are sometimes grown. I have recently seen some of these in the Ambála District, and also shawls manufactured from the produce.

Methods of improvement.

6. There appear to be three recognised methods of improvement:—

(*i*) by the introduction of suitable exotics;

(*ii*) by selection from indigenous varieties;

(*iii*) by hybridisation.

The last, which may perhaps be the most promising, must at present be dismissed with the remark that an expert is required to carry the process to a conclusion. Our Agricultural staff have crossed a number of varieties, but the essential operations of choosing and fixing a type from among the mixed hybrid progeny are naturally beyond them.

Trials with American cottons in 1902 and 1903.

7. In 1902, as already reported, the Inspector General of Agriculture tried several American cottons at Hissar, where he was impressed with their healthy appearance. These included newly imported varieties and some which had been acclimatised with much care at the Cawnpore Experimental Station. These experiments were transferred to Lyallpur in 1903. In addition, in 1903, half an acre was sown with *Narma* which was collected for me by Messrs. Mela Ram, Cotton Spinners of Lahore. *Narma*, sown on May the 2nd, gave an outturn of 675 lbs. per acre, and a percentage of 33 per cent. of lint. The yield was as heavy as that of the best local varieties. *Cawnpore Acclimatised*, sown on April the 4th, gave an outturn of 679 lbs. per acre, but sown on May the 5th, fell to 345 lbs. per acre. The proportion of lint was in each case 34 per cent. *Punjab Narma* was tried in my office garden and in the Agri-Horticultural Gardens, and in both cases showed a luxuriant growth and bore well, although the plants suffered from being planted too close together and from not being topped. The outturn on $\frac{1}{4}$ of an acre in the Lahore Gardens, sown on the 4th of May, was at the rate of 508 lbs. per acre, the percentage of lint being 33. The newly imported varieties were received late and were only sown at Lyallpur on May the 15th. The outturns were insignificant, but those plants which came to maturity were healthy. If allowance be made for inexperience in treating these varieties, the results are encouraging and some useful lessons were learnt as to their cultivation.

American cottons in 1904.

8. In the spring of this year, at the suggestion of Mr. Mollison, a more ambitious experiment was tried with exotics in the Jhelum and Chenáb Colonies. Some acres were sown in the farms at Lyallpur and Sargodha and, in addition, five grantees at Lyallpur and four at Sargodha each provided four or five acres, a guarantee being given against loss. Sowings were made in April and early May. Two two-coulter drills sowing in rows $2\frac{1}{2}$ feet apart were kindly supplied by Mr. Mollison from Gujarát, with two pairs of bullocks and two trained cultivators. The operations have been in charge of M. Ijáz Hosain, Agricultural Assistant. The varieties sown were *American Acclimatised*, including *Narma*, *Cawnpore* and *Dharwar*, newly imported *Americans*, *Egyptians*, and *Bombays*. I visited all the plots except two early in November. All the acclimatised Americans have done well. The newly imported *Americans* germinated less evenly but are promising. The *Egyptians* and *Bombays* will probably give an insignificant outturn, or none at all. At the time of my visit, the cold was already beginning to arrest their development. As pickings are still in progress, the results can only be described in general terms. It is also impossible, with an uncertain crop like cotton, to base deductions on the observations of two or three years. But we have undoubtedly good reason to persevere with the American varieties. The Cawnpore experiments have already established that

they can be grown in Northern India and the problem to be solved is, can they be grown in the Punjab as a remunerative crop? The answer was, I believe, considered to be in the negative in the United Provinces. Perhaps, the drier climate of the Central and South-West Punjab may be more favourable. In any case, no difficulty is anticipated in getting some 700 acres sown next year as a speculation by those colonists who provided plots this year, or who saw the crops on the ground. These men will be brought into correspondence with the local spinners and other buyers. The quantity of cotton produced will be enough to command a fair market price. Should the venture turn out sufficiently profitable, further trials and perhaps a considerable extension of cultivation would be assured. It will be necessary to address the Irrigation Department with a view to the grant of facilities for fortnightly waterings.

Improvement by selection.

9. Selection from indigenous varieties is an extremely slow method of improvement. The result of several years' work at Cawnpore is practically *nil*. Hybridisation would shorten the process, but we are not in a position to do this at present. Selection is receiving due attention at the Lyallpur Farm, the best local varieties having been collected there, and pickings being made from the best plants. At the instance of the Government of India, however, who have placed Rs. 5,000 at our disposal, the Local Government providing another Rs. 5,000, measures have been initiated towards checking the deterioration of seed and mixing of varieties consequent on the establishment of ginning mills. Seed of the best varieties, and of the best pickings, is being selected pure in the Lahore, Gurgáon, Hissár and Dera Gházi Khan Districts and in the Lyallpur Colony. If care is taken, there may in about three or four years' time be an enormous quantity of seed available from this selected seed. The policy adopted has been to make a thorough selection in the first instance and to only employ men who are willing to take trouble. This will in the end give the best results. The quantity of the seed can be increased at a very rapid rate each year. The Agency employed is that of prominent cultivators who take an interest in seed selection.

Selection of seed by ginning-mill proprietors.

10. Selected seed is being hand-ginned as a precaution. But in a year or two the cost of treating large quantities of seed in this way will be prohibitive. I hope that the owners of ginning mills will then come forward and co-operate and that, once having made a start, they will endeavour to maintain the general quality of the local produce. The deterioration of seed has been brought to their notice this year. They have been urged to gin separately for seed purposes good lots of cotton of the 2nd and 3rd pickings. If this is done, sound and vigorous seed will be distributed. This seed will be of mixed kinds but nevertheless a distinct advance will have been made. The cost of selection on these lines will be insignificant and the mill proprietors have a direct interest in the matter.

W. RENOUF,
Director of Land Records and Agriculture, Punjab.

Central Provinces.

Extension of area under cotton.—The area under cotton in the Central Provinces has doubled in the past ten years, and now amounts to 1¼ million acres. The principal reasons for this large increase are that the seasons of light rainfall have been exceptionally favourable for cotton (and unfavourable for other staple crops, such as rice, wheat and the like), that the yields have been good, that a brisk export trade has given high prices, and that its cultivation does not demand much capital expenditure by poor cultivators. The history of cotton cultivation in the Central Provinces is instructive. In the early sixties a substantial amount of cotton was grown in almost every district, the produce being locally made into hand-spun yarn. The opening of the main railway lines, with their imports of machine-made yarn and cloth, injured severely the village industries of hand-spinning and weaving, with the result that cotton cultivation dwindled into insignificance in many tracts. This was accompanied by an enormous increase in certain tracts adjoining the railways which were specially suited for cotton, a great impetus being given by the demand for cotton during the American War. The conditions thus changed from a widely-spread cultivation for local use to a concentrated cultivation along the railway for export. Cotton cultivation is now confined to a narrow belt about 40 miles wide on each

side of the railways. This bulky crop cannot profitably be grown with a longer lead by road to a railway. There are other tracts which, I believe, would grow cotton if they could be provided with railways. The construction of light feeder railways in such tracts would be a great encouragement to the extension of cotton. The Department of Agriculture should make a cotton survey to ascertain what tracts seem primarily to be suited to cotton, by an examination of the local conditions of soil, rainfall, temperature and the like. An examination of the past statistics upon the lines indicated above may give some useful information. The conclusions of this survey can be tested by the establishment of small experimental plots for the trial of cotton. Such experimental plots have been started for three years in the Bilaspur and Raipur Districts.

2. *Improvement of staple.*—The variety now almost exclusively grown (locally known as *jari*) is a coarse short staple cotton suitable only for counts of 10s to 12s. This coarse variety has driven out finer varieties, because it is hardy, capable of withstanding bad seasons and disease, and gives a heavy yield with a high percentage of lint to seed (33 per cent.). This cotton commands a high price for export to Continental Europe and Japan, a price higher than it would obtain as a cotton only, because it is peculiarly suited for admixture with wool. A part of the Central Provinces used to grow one of the finest cottons of India (locally known as *bani* and commercially as *Hinghanghats*), suitable for counts of 30s to 40s. It has almost disappeared, because the price does not compensate for the small yield, the riskiness of the crop and the small percentage of lint (25 per cent.). In order to improve the grade of cotton, the Department of Agriculture must produce a fine cotton, which will give as large a profit as the coarse *jari*, by a better yield, a more certain crop and a larger percentage of lint than is given by *bani*. Exotic cottons have generally failed. An acclimatized American Upland Georgian cotton has been grown for many years on the Nagpur Experimental Farm, which gives fairly good results. Some quantity of seed has recently been distributed, but I am not sanguine that any important result can be achieved with this cotton. New American varieties fail completely, because they will not stand the heavy rainfall of the monsoon. Egyptian varieties, if sown after the rains, can be grown with fair success with irrigation, but there are many crops that pay better for the heavy expense of irrigation. The local conditions are peculiar. There is a fairly heavy monsoon rainfall followed by almost complete drought. The soil is too wet during the rains for delicate cottons, and dries too rapidly for prolonged growth during the fair season. The fine cottons of Broach cannot be grown, because they wither before coming to maturity during their eight months' period of growth. What is required is a hardy plant that will withstand the heavy monsoon rainfall and mature rapidly in about five months.

3. *Improvement of methods of cultivation.*—Experiments are in progress to test methods of cotton cultivation, different kinds of manures, rotation of crops, seed selection and the like. They have as yet failed in finding out any important practical improvements over the best native methods. There are, however, many parts where the cultivation does not reach a high standard, more particularly tracts where the extension of cotton is of a comparatively recent date. In some of these parts, small demonstration farms have been opened to teach the ryots the best methods of cultivation. Some impression has been made, but years of steady work are required to introduce new methods into general use.

4. *Seed selection.*—The best cultivators in the best tracts carefully select their seed. One particular tract bears a high reputation for its seed. It commands a high price in the market, cultivators from other parts going there to purchase. Experiments are being made to induce some cultivators to grow cotton primarily for seed, upon principles which differ somewhat from those followed in growing the crop for lint, with a Government guarantee against loss of profit. The evils resulting from ginneries are undoubted. Arrangements have been made with some ginneries that they should select the best carts of cotton purchased by them at the time that the second and third pickings (the best for seed) come to market, remove the stained lint by hand-picking it over, and gin separately, the seed being bought by Government for distribution to cultivators. Government has guaranteed to pay the small

extra cost incurred by ginneries in carrying this out. Arrangements have also been made to select some of the best fields of cultivators, remove stray plants of other varieties and weakly plants, and take the second and third pickings for seed distribution. Such measures can, however, do little good. What is required is plant-to-plant selection on a considerable scale.

5. *Proposals.*—The lines of work most likely to give useful results are (1) Hybridization in order to create an improved variety, and (2) plant-to-plant selection for improvement of existing varieties. The staff of the Agricultural Department is quite inadequate to deal with these problems. There is not a single European specialist. The few natives (with a diploma in agriculture from the Poona College) cannot cope with such a task. The appointment of at least one Economic Botanist with the necessary subordinate staff is essential. The Experimental Farm at Nagpur devotes a considerable area to cotton, but it is not on a large enough scale for the work. At least one large Government cotton farm should be started to take up the work on the above lines, and for which a strong expert staff should be appointed.

F. G. SLY,

Ex-Director of Land Records and Agriculture,
Central Provinces.

PUSA,
The 9th January 1905.

Assam.

There is not much to be said on behalf of Assam in regard to cotton cultivation. It would not be correct to say that there is no cotton grown in Assam, as there is in fact a considerable quantity of a particular type, but it is grown under conditions totally different from those found in provinces where cotton is a prominent crop. The cotton of Assam is all grown in the hills, particularly the Garo Hills. This cotton is of a peculiarly short staple, not ordinarily (perhaps never) used for spinning but for mixing with wool. A large quantity is exported to the Continent of Europe for this purpose, and when the price of wool is high, the demand for this cotton is greater, and it is even known to command prices which are high by comparison with the finer cottons.

Besides the Garo Hills, this hill cotton is grown by hill tribes in the Mikir Hills, Naga Hills, Khasi Hills, etc. The area and outturn are a matter of estimate only, as no reliable statistics are available for these wild tracts. The latest figures of export are not available at the time of writing, but a recent return puts them at 32,000 maunds valued at 1·90 lakhs.

2. It has been said that cotton in Assam only grows in the hills. In the published statistics some few small areas in the plains appear to be cultivated with that crop, but they are quite insignificant. In the homesteads of Hindus there are found occasional plants. A trial is being made by this Department with a few seeds of tree and other cottons, but the results are most unpromising even when, as in most cases, the seed has not failed to germinate. Moreover, if we succeed in growing a few plants, it by no means follows that cotton can be grown so as to be more remunerative than other crops already known to thrive. For one reason labour is scarce and dear. The system of cultivation in the hills is not one that could be pursued elsewhere. It is called "jhuming," *i.e.*, the hillmen burn and clear a patch in the jungle and abandon it to clear another site after perhaps three years of cultivation. The hill cotton is generally exported unginned. It has one remarkable characteristic as determined by Professor Gammie, *viz.*, an unusually large percentage of lint. The lint is nearly 50 per cent. of the unginned commodity. The cotton fetches a fair price for the special purpose already indicated.

3. It is well known that the rainfall of Assam is heavy. It ranges from 67 inches to 100—150 and even more. This is the record of the principal civil stations. Only in a few restricted areas is it known or supposed to be less than 60 inches, which is generally found to be in India about the limit for cotton cultivation. Cotton may, perhaps, be grown successfully

APPENDIX C.

PROGRAMME FOR THE FIRST MEETING OF THE BOARD OF AGRICULTURE AT PUSA, COMMENCING THE 6TH JANUARY 1905.

SUBJECT I.—*The Programme of work of the Imperial Department of Agriculture.*

A consideration of the programmes submitted by—

(*a*) The Director, Pusa Research Station;
(*b*) The Agricultural Chemist;
(*c*) The Cryptogamic Botanist;
(*d*) The Entomologist.

2. Provincial Directors should examine them to see whether they meet the requirements of their provinces. Imperial Exports should examine them to see whether the programmes of branches, other than their own, meet their requirements.

SUBJECT II.—*The Programmes of work of the Provincial Departments of Agriculture.*

3. A consideration of the programmes submitted by—

(*a*) Bombay,
(*b*) United Provinces,
(*c*) Bengal,
(*d*) Madras,
(*e*) Punjab,
(*f*) Burma,
(*g*) Central Provinces,
(*h*) Assam.

4. The Imperial Experts should consider whether the programmes meet their requirements, and whether they can suggest improvements. The Provincial Directors should consider whether the programmes of other provinces can be improved so as to meet any special requirement of their province or to co-ordinate their work.

SUBJECT III.—*Extension and Improvement of Indian Cotton.*

5. A general discussion as to the best methods of giving effect to the policy laid down in Government of India letter No. 23—9-36, dated the 16th September 1904, dealing with—

(*a*) The botanical examination and classification of all existing varieties of cotton, both wild and cultivated;
(*b*) The introduction of better varieties and improved methods of cultivation;
(*c*) The provision and distribution of good seed of the verieties ordinarily grown.

6. It would be an advantage, where this has not already been done, if each province could clearly define the conditions of the problem as it affects their own province. I attach a note indicating the conditions in the Central Provinces. The Board could then consider the programme of proposed work of each province best suited to the local conditions.

7. The Board should also discuss the best means of giving practical effect to the proposals of the Government of India for the collection and distribution of the best seed of existing varieties.

SUBJECT IV.—*The Extension of Jute Cultivation.*

8. Mr. Mollison considers that the cultivation of jute may be extended from Bengal to some other parts of India, *e.g.*, Burma, the delta areas of Madras, and perhaps in parts of Bombay. In some parts jute is sown practically as a dry crop and does well, if the soil is continuously wet or lightly

flooded after the plants have made some progress. This proposal may be considered, and, if approved, arrangements made for the experimental growth of jute.

SUBJECT V.—*Irrigation.*

9. A discussion on the experiments arranged to give effect to the recommendations made by the Irrigation Commission in Chapter XI of their Report. The records of my office do not give full information of the programmes arranged by all provinces. It is hoped that a general discussion of these programmes will assist officers by giving them information which may help in improving or extending the experiments. In this discussion the following, among other, questions may be considered :—

(*a*) The amount of seepage in long water-courses;

(*b*) The best methods of leading water over the fields and of preparing the land to receive it, *e.g.*, broad irrigation, the Poona system of narrow beds the length of the plot, the Baroda system of furrow irrigation, the small bed (*Kiari*) system;

(*c*) The testing of the duty of water; the minimum quantity of water for the successful cultivation with $\frac{\text{(a) a full yield}}{\text{(b) a fair yield}}$ of important irrigated crops in years of $\frac{\text{(c) normal}}{\text{(d) deficient}}$ rainfall;

(*d*) The best methods of giving water to principal crops; number of waterings and depth of each watering;

(*e*) The manures that can be used to best advantage with irrigation;

(*f*) The value of irrigation for crops not ordinarily irrigated, *e.g.*, high-grade cotton;

(*g*) The best mechanical means of measuring the quantities of water used in irrigation;

(*h*) The best means of preventing percolation of irrigation water from one experimental plot to another.

10. *Irrigation from wells* may also be discussed, with reference to (*a*) the types of wells suitable for particular soils and localities; (*b*) the best boring apparatus for testing the presence and depth of subsoil water; (*c*) the use of oil-engines for raising well-water.

11. The experiments in progress at Cawnpore and Pusa for investigating the moisture condition of the soil may be considered; also the advisability of extending them to other farms.

SUBJECT VI.—*Agricultural Education.*

12. Mr. Mollison proposes during his furlough to visit Agricultural Colleges in England, consult Professors, and draft a curriculum of studies for the Pusa Agricultural College. This subject is, therefore, not ripe for discussion. But the Board can usefully discuss how many pupils may be expected to attend from each province, and at what stage of their agricultural education. Proper provision can then be made for them at Pusa. The Board may also discuss what inducements in the shape of scholarships and promises of future Government service, it will be advisable for Provincial Governments to offer to pupils.

13. In regard to education generally, the Board may discuss the arrangements made by Local Governments for the training of village schoolmasters, so as to make them more capable teachers of the reading lessons, dealing with agricultural subjects and of illustrating them by object-lessons drawn from agriculture. In Bombay, this training is given at the regular Training Colleges under the Education Department, at each of which a small farm has been started. In the Central Provinces, each village schoolmaster goes through a special course of instruction for six months at the Agricultural School on the Experimental Farm under the control of the Director of Agriculture. A discussion of the advantages and disadvantages of each system may lead to the formulation of a definite scheme that can be recommended for general trial.

14. Another subject that the Board may discuss is the training of Farm Overseers in practical work at (*a*) Pusa and (*b*) Provincial Farms.

15 The Board may also consider the advisability of opening classes at certain Experimental Farms for the training of the sons of agriculturists in practical farming.

SUBJECT VII.—*Veterinary.*

16. A discussion of the schemes in progress for the improvement of the breeds of agricultural cattle, for the breeding and rearing of bulls, and for the prevention and cure of disease.

SUBJECT VIII.—*Publications.*

17. The existing publications, dealing with the work of the Department of Agriculture, are—

(1) Annual Reports of the Departments of Agriculture;
(2) Annual Reports of Experimental Farms;
(3) Bulletins of the Department of Agriculture;
(4) Agricultural Ledgers;
(5) Indian Museum Notes (Entomology).

18. The first are largely confined to administrative matters, and are clearly unsuited for the publication of papers on scientific or practical agriculture.

19. The second are records of the annual work of Experimental Farms. The Government of India have lately suggested that the annual report should be confined to a review of management, of the general lines of experiment undertaken and their progress, and of any positive action taken to make the farm and its teachings useful to the agriculturist; that it should not be a detailed record of experiments, which should not be published until they have become sufficiently advanced to yield definite results, when an Agricultural Ledger should be issued. The Board may consider this proposal.

20. The Government of India (letter No. 1259—33-2, dated the 12th September 1904) has made an important distinction between Bulletins and Ledgers. 'In deciding whether a note or report should be published in bulletin or ledger form, the principle to be followed is that what is published for the information of the reader should go into the Ledgers, while what is circulated in order to obtain further matter for the information of the writer should go into the Bulletins.'

21. Proposals have already been submitted to the Government of India recommending that the publication on Entomology known as "Indian Museum Notes" should be given up in favour of a somewhat similar publication, to be entitled 'Notes on Entomology," and to be edited by the Entomologist to the Government of India. It is intended that this publication should be a common medium for the publication of the results of work done in India by the Government Entomologist, by provincial officers and by private contributors.

22. Several officers have reported that the Agricultural Ledger does not meet their requirements, for the following, amongst other, reasons:—(*a*) The irregularity of its appearance, (*b*) Unsuitability of size, (*c*) Unsuitability of type and paper, (*d*) Want of illustrations, (*e*) Want of a good index. Its object is to provide matter for the revision of the Dictionary of Economic Products, which is quite different from the object of agricultural publications.

23. The Government of India desire that the Board should consider a proposal for the publication of an Agricultural Journal. If this is recommended, the following points should be considered:—(*a*) The object of the Journal—whether it should be a medium for the issue of scientific reports for the information of scientific experts, or a medium for the publication of information for the agriculturist and the general reader interested in agriculture, or both; (*b*) the subject-matter and its division into sections; (*c*) the number of issues to be made each year; (*d*) the general editing and the editing of the different sections; (*e*) the size, type and other matters connected with its form; (*f*) its price and free distribution list.

SUBJECT IX.—*Measures to bring the Imperial Experts into closer touch with Provincial Departments of Agriculture.*

24. Amongst the proposals made under this head, the Board may consider:—

(*a*) Rules regarding direct correspondence between Imperial Experts and (1) Provincial Directors and (2) Deputy Directors.

(*b*) The training of provincial assistants in special branches of work by the Imperial Experts; Entomologist, Cryptogamic Botanist, Agricultural Chemist, and the like.

(*c*) The provision of Rest-Houses at provincial Experimental Farms.

(*d*) The publication of a Quarterly Journal.

(*e*) Imperial Experts should report to Directors the general results of a tour as soon as it is completed.

(*f*) Provincial Experts taking up a special subject (*e.g.*, sugar) should be given facilities for extending their enquiries at Pusa and also in other provinces.

(*g*) Imperial Experts should make a special endeavour to meet the Provincial Directors during their tours and to discuss with them the work of their Department.

SUBJECT X.—*Measures to bring the Provincial Departments into closer touch with Agriculturists.*

25. The varying local conditions make it impossible to lay down any definite scheme, but the following measures have been suggested, some of which may be found suitable:—

(*a*) A more extended use of publications, both English and vernacular, consisting of (1) bulletins or leaflets describing improvements that have been tested and that can be put to practical use; (2) a vernacular Agricultural Magazine;

(*b*) Frequent communiqués to the vernacular press;

(*c*) The formation of District Agricultural Associations;

(*d*) The establishment of demonstration plots, more particularly outlying plots within easy reach of Experimental Farms;

(*e*) The establishment of classes at Experimental Farms for the training of agriculturists in practical farming;

(*f*) Agricultural Shows;

(*g*) The utilization of the agency of Court of Wards Estates;

(*h*) Inducing large landowners to act as pioneers of improvements;

(*i*) Inducing cultivators to visit Experimental Farms. (The provision of suitable accommodation for such visitors at each Farm.)

(*j*) The selection and distribution of good seed upon the lines of the United Provinces plan.

F. G. SLY,

Offg. Inspector General of Agriculture in India.

NAGPUR;

24th December 1904.

EXTENSION AND IMPROVEMENT OF COTTON IN THE CENTRAL PROVINCES.

Extension of area under cotton.—The area under cotton in the Central Provinces has doubled in the past ten years, and now amounts to 1¼ million acres. The principal reasons for this large increase are that the seasons of light rainfall have been exceptionally favourable for cotton (and unfavourable for other staple crops, such as rice, wheat and the like), that the yields have been good, that a brisk export trade has given high prices, and that its cultivation does not demand much capital expenditure by poor cultivators. The history of cotton cultivation in the Central Provinces is instructive. In the early sixties a substantial amount of cotton was grown in almost every district, the produce being locally made into hand-spun yarn. The opening of the main railway lines, with their imports of machine-made yarn and cloth, injured severely the village industries of hand spinning and weaving, with the result that cotton cultivation dwindled into insignificance in many tracts. This was accompanied by an enormous increase in certain tracts adjoining the railways which were specially suited for cotton, a great impetus being given by the demand for cotton during the American War. The conditions thus changed from a widely-spread cultivation for local use to a concentrated cultivation along the railway for export. Cotton cultivation is now confined to a narrow belt about 40 miles wide on each side of the railways. This bulky crop cannot profitably be grown with a longer lead by road to a railway. There are other

tracts which, I believe, would grow cotton if they could be provided with railways. The construction of light feeder railways in such tracts would be a great encouragement to the extension of cotton. The Department of Agriculture should make a cotton survey to ascertain what tracts seem primarily to be suited to cotton, by an examination of the local conditions of soil, rainfall, temperature and the like. An examination of the past statistics upon the lines indicated above may give some useful information. The conclusions of this survey can be tested by the establishment of small experimental plots for the trial of cotton.

2. *Improvement of staple.*—The variety now almost exclusively grown (locally known as *jari*) is a coarse short staple cotton suitable only for 10^s to 12^s. This coarse variety has almost completely driven out finer varieties, because it is hardy, capable of withstanding bad seasons and disease, gives a heavy yield with a high percentage of lint to seed (33 per cent.). This cotton commands a high price for export to Continental Europe and Japan, a price higher than it would obtain as a cotton only, because it is peculiarly suited for admixture with wool. A part of the Central Provinces used to grow one of the finest cottons of India (locally known as *bani* and commercially as *Hinghanghats*), suitable for counts of 30^s to 40^s. It has almost disappeared, because the price does not compensate for the small yield, the riskiness of the crop and the small percentage of lint (25 per cent.). In order to improve the grade of cotton, the Department of Agriculture must produce a fine cotton, which will give as large a profit as the coarse *jari*, by a better yield, a more certain crop and a larger percentage of lint than is given by *bani*. Exotic cottons have generally failed. They will not stand the heavy rainfall of the monsoon. They can be grown with fair success with irrigation, but there are many crops that pay better for the heavy expense of irrigation. The local conditions are peculiar. There is a fairly heavy monsoon rainfall followed by almost complete drought. The soil is too wet during the rains for delicate cottons, and dries too rapidly for prolonged growth during the fair season. The fine cottons of Broach cannot be grown, because they wither before coming to maturity during their eight months' period of growth. What is required is a hardy plant that will withstand the heavy monsoon rainfall and mature rapidly in about five months. The breeding of new varieties of cotton by cross-fertilization seems the most likely solution of the problem.

3. *Improvement of methods of cultivation.*—Experiments are in progress to test methods of cotton cultivation, different kinds of manures, rotation of crops, seed selection and the like. They have as yet failed in finding out any important practical improvements over the best native methods. There are, however, many parts where the cultivation does not reach a high standard, more particularly tracts where the extension of cotton is of a comparatively recent date. In some of these parts, small demonstration farms have been open to teach the ryots the best methods of cultivation. Some impression has been made, but years of steady work are required to introduce new methods into general use.

4. *Seed selection.*—The best cultivators in the best tracts carefully select their seed. Such seed commands a high price in the market, cultivators from other parts going there to purchase. Experiments are being made to induce some cultivators to grow cotton primarily for seed, upon principles which differ somewhat from those followed in growing the crop for lint. Some Government seed farms might also be started. But this can only affect the local coarse variety, until the Department of Agriculture produces a suitable fine variety.

F. G. SLY,

Offg. Inspector General of Agriculture in India.

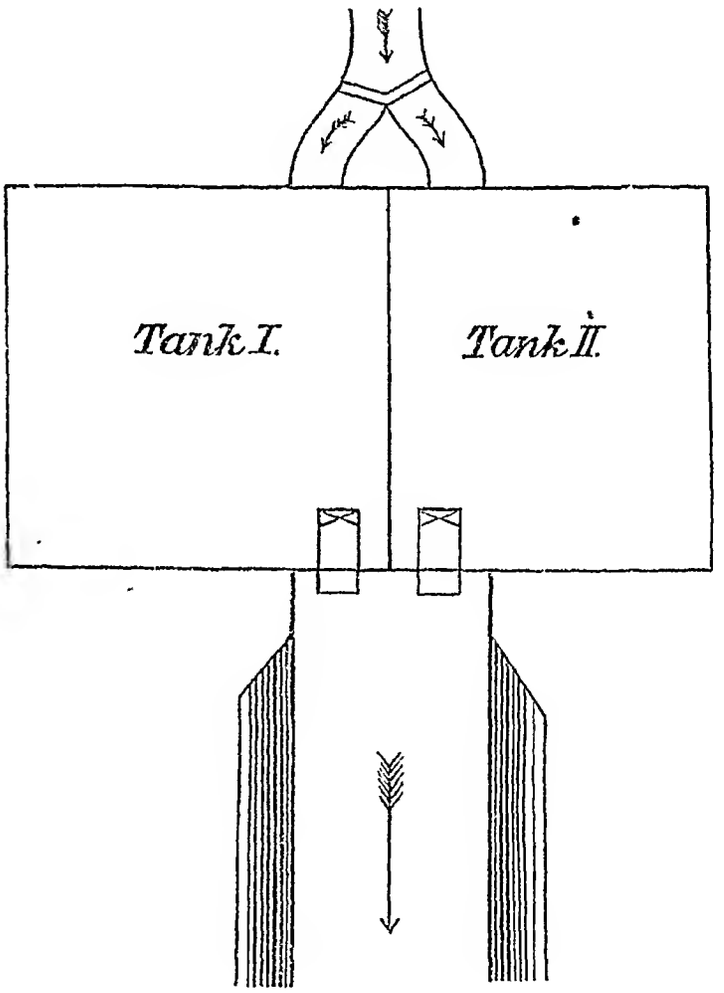
NAGPUR;
24th December 1904.

Extract paragraph 6 of letter No. 104 I.—3023, dated Nagpur, the 9th July 1904, from the Superintending Engineer, Irrigation Circle, Central Provinces, to the Commissioner of Settlements and Agriculture, Central Provinces.

With reference to the measurement of supplies used for irrigation, I think they must be very accurately made to be of any value. In my opinion count-

ing the number of "Mots" is not sufficiently accurate. Then metres are expensive, and they can be only used on pipe lines. I think that actual correct measurement is the only satisfactory way of dealing with the question. To get reliable results expense must be incurred, but the money will be well spent. I recommend, therefore, that at each source from which water is drawn for irrigation, two suitable sized masonry tanks be constructed as shown in the accompanying sketch, so that while irrigation is being done from one the other can be filled.

The tanks should be of exactly the same size, and each should be fitted with an outlet pipe controlled by a proper water works sluice valve, so that no wastage may occur. As the contents of each tank will be known, all that the attendant will have to do is to enter a mark on a board kept for each tank every time he turns the water from it on to the fields. If two men are employed, one to irrigate and the other to fill the tanks, as will probably be the case where the filling is done by a "Mot," a system of brass tickets might be used. These could be issued to the irrigator in the morning, and he would give one to the filler every time he turned on the water from the tank. This system would check both men's work. Such tanks will not cost very much and they will be permanent. Their capacities may be regulated to suit the conditions of each case, but it will be an advantage to have them all the same size.



NOTE ON THE WORK TO BE DONE AT PUSA IN 1905-06.

Preliminary.

1. As I have had no opportunity of consulting the expert staff whose work and experiments will be given effect to during the coming year, I am unable to state exactly what the work at Pusa will be, and have confined myself to a general statement.

Arable cultivation.

2. Some 250 acres will be under cultivation during the coming year and subject to any arrangement which it may be necessary to make to meet the requirements of the experts, I propose to divide this amongst the crops shown in the following paragraphs.

Indigo.

3. Regarding this crop I propose to grow 20 acres of Java-Natal plant and 30 acres of ordinary plant, and I have to suggest that Mr. Bergtheil, who has been lent to the Government of Bengal, should be allowed to conduct the manufacture of this plant in the small Indigo factory at Pusa. In regard to this plant and its manufacture, there is much work and experiment to be done, but what course these will take can only be ascertained after consultation with the expert.

Cotton (30 acres).

4. The Inspector General of Agriculture has left a scheme for the cultivation of cotton to cover an area of 25 to 30 acres. It will comprise :—

(*a*) the growth of imported varieties which appear to do well in the soils of Behar,
(*b*) acclimatised exotics which have already shown vigour of growth,
(*c*) long staple indigenous varieties,
(*d*) tree cottons,
(*e*) all indigenous varieties for the purpose of botanical identification,
(*f*) cross fertilization between approved varieties,
(*g*) selection of seed.

Sugar (15 acres).

5. The area I propose to grow in this crop is 15 acres. It will contain the most important varieties that are being grown in different parts of India. Whether it will be possible to ascertain the yielding qualities of the different kinds or the effects of differential treatment of pests and diseases will depend upon whether experts will be available for this work.

Sunflower (4 acres).

6. I grew sunflower during the past year, but owing to an attack of caterpillars, which seriously damaged the crop, no reliable results could be obtained. I propose to renew the experiment this year.

Rice (15 acres).

7. A number of Bombay varieties of rice were grown on the farm this year, and I propose to continue this work and to increase the varieties by samples from Lower Bengal.

Tapioca (4 acres).

8. Several kinds of this plant will be grown and the produce prepared.

Fodder (60 acres).

9. A considerable area of about 60 acres of fodder will have to be grown for feeding cattle. A large amount of this will be made into ensilage.

Tobacco (10 acres).

10. A number of varieties of American, Java and Sumatra tobaccos will be grown on 10 acres, and it is proposed to cure these on modern principles.

Linseed (5 acres).

11. Several varieties of linseed have been introduced on the farm, and it is proposed to grow these for flax and seed.

Other crops.

12. Til, maize, sweet-potatoes, turmeric, ginger, jute, wheat, barley, oats, gram, mustard, opium, groundnut, arhar and some other crops will be grown and harvested in the usual way and seed of the best kinds kept for distribution.

Sericulture.

13. An area of 10 acres will be put under mulberries, and a small factory for the rearing of silkworms and the reeling of silk corresponding with this area will be erected. Much of this work will be under the care of the Entomologist.

Apiculture.

14. I desire to propose the cultivation of bees under the control of the Entomologist.

15. An area of some 20 acres has been set aside for a kitchen-garden for the cultivation and improvement of the best varieties of vegetables, both indigenous and exotic.

Horticulture.

Orchard.

16. An area of 25 acres has been set aside for fruit culture.

Botanical Gardens.

17. These will cover an area of some 15 or 20 acres, which will be planted with the best varieties of shrubs and trees procurable, and will be in charge of the Botanist.

Cattle-breeding.

18. Over 60 head of local cattle have already been purchased, and the remainder, to complete 200 head, will be secured during the coming year. In this connection some 400 acres of pasture land have been set aside, but a large portion of the fodder grown on the farm will be fed to them. It is intended to improve the cattle by process of selection and not by cross-breeding. Besides the local kind, 13 cows and 1 bull of Montgomery cattle from the Punjab have been bought. These will be kept separate from the local variety and are for the purpose of seeing how they will fare in these districts.

Grasses.

19. Connected with the cattle-breeding experiments is the important subject of grazing. I intend to attempt the cultivation of several kinds of grasses for permanent pasture and for hay-making.

Insect pests and diseases.

20. In connection with this subject, I desire to suggest that the Government of India may be advised to establish a system of control over the importation of plants and seeds into this country with a view of preventing the introduction from other countries of insect pests and fungus diseases, and that the Cryptogamic Botanist and the Entomologist be requested to suggest a method of treatment and the restrictions they would advise.

Proposals on general scheme.

21. In reference to the proposals on which the Inspector General of Agriculture has invited discussion in his Circular No. 1326—8, dated the 25th November 1904, I have to say:—

(*a*) That in order to bring the agricultural experts of the Imperial Department into touch with those of the Provincial Departments, I would suggest that they be allowed free intercourse with one another officially and otherwise, and that periodical meetings between them might be arranged for. That in case where a man has taken up a special subject, say at Pusa, for example sugar, that he should be allowed access to other provinces to conduct experiments there and to get the benefit of local conditions. Similarly, an expert taking up special work in the provinces, say cotton, may be allowed to carry out experiments at Pusa and in other provinces. In this way the greatest benefit would be obtained from specialised work; overlapping and waste of time would be prevented; and intercourse between all departments would be established.

(*b*) For regulating the work at Pusa Research Institute, College and Farm, so that it may be of the greatest use to the provinces, the following suggestions present themselves. It may be assumed that the chief reasons in founding Pusa station are to secure the following objects:—

(1) To introduce into the country a body of European experts for the purpose of raising the standard of agriculture and ameliorating the condition of industries.

(2) To provide a college where science and agriculture would be taught and young men prepared to become teachers and investigators in Pusa or stations in the provinces, or to take charge of rural agricultural classes, or be qualified as managers for estates and agricultural institutions.

(3) To have a farm on which the work of experts may be given a practical test, general farming taught, and where seeds and plants can be grown for improvement and instruction. To carry out the above work so that it may prove of the greatest use to the provinces, in other words to the country, I have to suggest that no pains should be spared to obtain the highest efficiency both amongst the staff and the students, and that opportunities be afforded for practical work and original research. This object being achieved, it will be possible to supply reliable men to demonstration farms and agricultural classes, specialists for original investigation, and a bureau of correct information on all subjects connected with agriculture.

(*c*) But our efforts must not end there. We have to bring the results of our work to bear upon the native cultivator and to get him to apply them to the soil and to the plants he cultivates on it. In considering this matter we have to disabuse ourselves of the ideas that obtain in European and other countries. Thus in England the cultivator of the land is either the proprietor or a farmer on lease of a considerable area, both of whom are educated men and command the use of capital, and both are interested in the welfare and improvement of agriculture. In India the cultivator is generally the occupancy tenant of a small holding, uneducated and without capital. His landlord, if he has any, takes no interest in agriculture. Next, the students from agricultural colleges at home, such as Cirencester and Wye, might well be expected themselves to give effect in the field to what they had learnt at college. But we cannot hope that this will be the case in India. The students at Pusa will not belong to the cultivator class, and are not likely even remotely to turn their hands to agriculture direct (I am speaking of course generally). We are thus confronted at the outset with the difficulty of how to get at the actual cultivator in the matter of improvements. I have in this connection to suggest the establishment of rural agricultural schools or classes running in touch with the agricultural departments of the different provinces and if possible in each village. It would be the most useful and wholesome education we could impart to the country as a mass. Teaching in these schools would have to be strictly in the vernacular, for the imposition of English on the cultivator would be unfair and unnecessary. It would have to be elementary and practical, but it would include the demonstration of any improvements from the experimental farms known to be a complete success. Unless some such arrangement, as I have described, is made to bring home to the cultivator the useful results of scientific agriculture and the work at our experimental farms and colleges, I do not think that the work at Pusa and the Provincial Departments will have practical effect.

22. One of the best measure of bringing the different departments and the public into touch with modern and improved agriculture are publications. I do not think these are established on a satisfactory basis, and I would suggest that discussion be invited on this subject with a view of placing this important matter on a better footing.

Publications.

B. COVENTRY,

Director, Agricultural Research Institute.

PUSA;

The 16th December 1904.

NOTE REGARDING THE NATURE OF THE WORK WHICH WILL BE IN PROGRESS IN THE DEPARTMENT OF THE AGRICULTURAL CHEMIST TO THE GOVERNMENT OF INDIA DURING THE YEAR 1905.

1. *Soils.*—The amount of readily available plant food in various Indian soils, with especial reference to Dr. Dyer's method for determining the amount of readily available phosphate and potash, has been experimented upon in the Laboratory and the Pot-Culture House during the past year, and the subject will be prosecuted further in the current year.

2. *Rain-water, Dew and Drainage-water.*—Specimens of these have been collected at Cawnpore and (of rain-water) at Dehra and the quantity of combined nitrogen determined and reduced to pounds per acre. Up to the present the amount of such nitrogen in the rain-water has corresponded with what has been found elsewhere. The amount of nitrates in the drainage water at Cawnpore has been larger than might have been anticipated.

It is proposed to construct some drain-gauges at Pusa during the current year in order to supplement the Cawnpore records.

3. *Water in Soils.*—The "percolation" or "drain-gauges" above referred to supply information regarding the quantities of water evaporating and percolating respectively. The Rothamsted gauges have also indicated that any water which passes to a certain distance from the surface does not evaporate but passes permanently into the underground water, and I wish to obtain similar information regarding the nature of the movements of water in Indian soils. It is intended to have two sets of gauges, the one to be entirely bare-fallow as at Rothamsted, and the other to carry crops. It is known that the quantities of water percolating under these two different conditions must be widely different, but data are entirely wanting as to what the actual quantities are.

In addition to percolation gauges it is hoped that a record may be kept of the actual amount of water in the soil at all depths down to 5 feet from the surface over a period of 12 months. An apparatus has been constructed for the purpose, and if it meets the end in view some very valuable data will be obtained, for at present literally nothing is known of the state of desiccation of Indian soils during the dry period. My own observations indicate that popular ideas on the subject are somewhat erroneous.

4. *Sugarcane.*—An Assistant Chemist was deputed last year and again this cold weather period to the Central Provinces to analyse the juice of varieties of sugarcane in the districts. This work is of the very greatest value, for the cane is undoubtedly poor in some places.

5. *Cyanogenesis in Plants.*—The cause of sorghum (*Andropogon Sorghum*) becoming poisonous has been explained by Dunstan and Henry's work, and it has since become evident that glucosides capable of yielding hydrocyanic acid are far more common than has been generally supposed. I have found the same to be the source of the "bitter principle" of Cassava, and have obtained very material quantities of prussic acid from Rangoon beans, val (*Dolichos lablab*) and field peas in the same way. Whilst there is still much to learn about the chemistry of these glucosides, there is also another part of the subject of which we know nothing, namely, the circumstances under which these glucosides are formed. In some cases they may be a normal constituent of the plant, but in juar "Dhurrin" is certainly an accidental one. At Poona in June of this year it appeared in a crop of this plant suddenly in such quantity that two bullocks died and others were made seriously ill before any assistance could be given, whilst juar of the same kind grown at Dehra in July to October was practically free from it. I propose to prosecute the enquiry in this direction, provided time can be found for it.

6. The analytical work regarding Indian food-grains and fodders and of samples of other products and manures will be continued. In the department of general analytical work the number of samples has gradually increased until this year it stands at 1,400. The time of the staff is in fact so fully occupied with this, that I experience great difficulty in carrying out other investigations. However, as a fifth assistant is to be shortly appointed, I hope to cope successfully with the year's programme.

J. W. LEATHER,

Agricultural Chemist to the Government of India.

21st November 1904.

Brief Note on the Publication of Agricultural information submitted to the Board of Agriculture, Pusa.

The method of disseminating information of an agricultural nature in most countries is so well known and so generally recognised as suited to the purpose that a word of explanation is perhaps necessary in introducing the subject to the first meeting of this Board. At the present time there are, in India, the Agricultural Ledgers and Agricultural Bulletins, and it is because these do not, in the opinion of some, answer the requirements of the case, that I venture to submit this note.

2. It will be convenient, I think, to consider the matter from a general stand point.

The objects of publications of a scientific or technical nature may be said to be two:—(*a*) to enable those who are interested in a subject to find readily what others are doing to further it, and (*b*) to bring the subject to the notice of as large number as possible so as to increase the general body of those who *are* interested in it.

3. To satisfy the first of these objects the publication should appear *regularly*. A publication which appears at irregular intervals is inconvenient, for the reader has no knowledge when he may expect a new issue. Then, too, an irregular number of issues in the year means that one cannot tell when a volume is complete; and to those who like to bind parts of books together a great disadvantage lies in this. Finally, a good index of subject matter and authors' names for each volume is a still more important condition. Those who require to constantly keep themselves informed of the progress of work in any subject know well the value of a good index and how it becomes almost impossible to find the time to search for information in its absence. Other considerations are that a publication should be in good type, on good paper and that it should be well illustrated. It is well known how very much an illustration assists the mind to understand the nature of an object which is new to the reader. I do not wish to appear unduly critical of the Agricultural Ledger, because, although it was formerly very imperfect in respect of its arrangement (it was neither paged nor indexed properly until four years ago), latterly it has been more perfect in this respect. But it does not fulfil other conditions. The number of parts per annum is indefinite and they appear at indefinite intervals, with the consequence that one does not know when to expect a new part, nor when the annual volume is complete. Indeed it seems that the arrangement of the Agricultural Ledger has been devised purely out of a regard to the attempt to align it with the Dictionary of Economic Products rather than to make its principal aim the dissemination of useful information among agriculturists. Again it is not, I think, creditable to the chief agricultural organ of a great country that it should be printed in a worse type and on worse paper than issues of a private nature. Consider for example the difference in style between the Agricultural Ledger and the booklet on *Sisal* Hemp by Messrs. Mann and Hunter, recently issued by the Indian Tea Association!

4. *The subject matter* of a technical organ is usually of a fairly circumscribed character, but this cannot be so readily fulfilled in one devoted to agriculture, on account of the great variety of subjects which are closely related to it. I think the chief aim of an agricultural journal should be to inform the *agriculturist* of what is of interest to him rather than to aid the scientist. By "agriculturist" I mean the man whose general education would enable him to assimilate such information. It will be readily understood that records of one and the same research may be conveniently placed before the scientist and the agriculturist in different forms. For example, in an investigation of a chemical nature, technical details, formulæ, etc., are not of consequence to the agriculturist, who is only concerned with the general practical outcome of the work: to the chemist on the other hand it is of every importance that a record of such technicalities should become available. The requirements of the agriculturist may be most readily met by the periodical publication of articles explaining the advances that have been made in any particular subject. To my mind excellent examples of this class of publication are found in the Journal of the Royal Agricultural Society of England and the Year Book of the Department of Agriculture, United States of America, or the Journal of the Board of

Agriculture, London, though the latter does not come up to the standard of the former in some respects.

5. Again, annual details of the field experiments which may be in progress over a series of years are not of pressing importance to the general agriculturist, who prefers to know the final outcome of an experiment and becomes impatient of an incompleted work. Annual records of experiments must naturally be kept, and there is perhaps no more convenient method than the present one, namely, the annual reports of Experimental Farms, for these are known and generally supplied to those who are actually engaged on similar work.

6. But it is also most desirable that a record of scientific investigation should be offered, independently of this, to scientific bodies who are particularly concerned with the subject. Experts are, therefore, usually encouraged to publish information (provided that it has no technical value which should be kept secret) before the learned societies quite irrespective of what they may publish for the general body of agriculturists. Such communications naturally add to the credit of the Institution to which an expert may belong.

7. Admittedly the precise nature or character of any article written in agricultural organ must depend on the subject. In the "Year Book" these are all compiled from the results of work accomplished or partly accomplished by different observers; the journal of the Royal Agricultural Society provides articles of this nature, but also detailed reports on experiments at Woburn, reports on special subjects at annual shows, and, thirdly, brief articles similar to the first named, but much shorter.

8. These seem to be the chief general aspects of the matter, and turning to our Indian requirements in particular, it cannot be doubted that there is very urgent need for the issue of an agricultural organ of a better type than those which at present exist. The generality of planters and agriculturists look askance at Government annual reports. There are several reasons for their unpopularity, such as the inconvenient size, their multiplicity, and the comparative difficulty in obtaining them, the style which is essentially "official" together with the general absence of diagrams. Their multiplicity is, however, perhaps their greatest weakness, and the Agricultural Ledger has similar defects. A journal, popular in form, contributed to by all those unofficial, as well as official, who are engaged in agricultural experimental work in India, having as its subject the dissemination of that part of our Indian work which has reached a practically useful stage, together with similar information from other countries, would surely find many readers even at the present day in India, and bearing in mind the impetus which Government is giving to agriculture now, a considerable increase in this number should be realised at no distant time. I think that not only all planters, but many English-speaking zemindars, would find it worth their while to take it. To meet this general demand it should, however, embrace not only general agriculture, but the important technical crops, such as tea, tobacco, coffee, etc., among its subjects.

9. Regarding the cost of such a journal it is perhaps difficult to offer a proper estimate. The journal of the Royal Agricultural Society costs about £2,000 per annum, including editors' and contributors' fees, and has an issue of about 10,000 copies. It is not likely that such a large issue could be made in India at present, but it seems likely that 1,000 purchasers might be found willing to pay £1 per annum for a really good volume, and Government might be asked to make a substantial contribution to it. On the other hand, if an organ of indifferent style were issued or if it did not command the sympathy of the whole body of agricultural experts in India, its circulation would be much more limited, and it would not attain that position which might be expected of the one I contemplate in this note. It should not be distributed *gratis* to any one. It is a well known axiom of life that what has to be paid for is appreciated, whilst that which is given is often cast aside.

10. *The distribution of a Journal* is a point to which I made reference in the first paragraph. Obviously it is impossible to find unaided any large number of subscribers. I believe the Agricultural Ledger is distributed mainly to district officials, and it certainly has not found its way generally into the libraries of planters or agriculturists. In the Dun I know the tea planters do not see those numbers of it which deal with their industry, although they

(iv) The technical records of experimental research would find a more suitable place in the Journals of the Learned Societies in England than in either of the Agricultural Ledger or an Agricultural Journal. Moreover, the acceptance of such work by these Societies would be to the credit of the Institutions or Departments to which the authors may belong.

(v) Detailed records of the work in progress at Experimental Farms would be published in Government Annual Report as at present.

J. WALTER LEATHER,
Agricultural Chemist to the Government of India.

Outline work of the Cryptogamic Botanist for the year 1905 with special reference to that which will be carried out outside head-quarters.

It is proposed to continue the work connected with the rusts of wheat and barely. The chief varieties of the parasites in India are now fully known, and their distribution approximately determined. The influence of other plants on the disease has been shown to be slight, and little more attention need be paid to this aspect of the matter. The problem then narrows itself down to the following two questions. First, is the origin of the disease anew each year due to rust spores either from first year's crop or from the atmosphere? or is it due to a hereditary germ within the seed? And second, how should we proceed in order to obtain reliable rust-resistant wheats?

With the former I need not deal at present, since it is a technical question and is under study by Mr. Hayman and myself. The latter is now in a position to be vigorously taken up, and from the importance of the subject I should like to enter into it somewhat fully.

In order to arrive at reliable results, each of the chief climatic divisions within the rust-affected area should work independently. For it is established that the rusts are not present to the same degree in each of these divisions, and a wheat which resists a particular rust in one division may be exposed to the attacks of another when transferred elsewhere. Not alone does resistance to one rust by no means imply resistance to the others, but the property of resistance is sometimes diminished or destroyed by removal to a different climate. And the local prejudices in favour of certain classes of wheats must clearly be respected. Lyallpur, Cawnpore, and Hoshangabad seem to be already particularly marked out for this work. In the Punjab, however, except in the heavily irrigated canal colonies for which Lyallpur will serve as a representative locality, rust is not at present nearly so dangerous as elsewhere. For Bengal, which appears to be the special home of *Puccinia triticina*, a station would seem to be necessary, and other localities can probably be found where work of this kind should be carried on.

Having selected the locality the next step is to collect a number of varieties, and get them true to seed. In this, clearly, all sorts well spoken of locally, as well as selected wheats from outside, should be included. They must then be exposed to conditions favourable to rust, as far as can be done. For this heavy irrigation is essential. At Hissar, exceptionally heavy irrigation induced severe rusting at the Cattle Farm in 1903, while the district as a whole was free from rust. At Cawnpore, Mr. Hayman has found that heavy irrigation is all that is required for the plot of wheat which he uses to obtain material for his work on the rust fungi. There is a danger in this which must be borne in mind. It is possible that a wheat, which has shown itself resistant to rust induced by soil waterlogging, may fail when the rust arises from natural climatic conditions, such as occur in a bad rust year. Mr. Moreland has shown that humidity of the air in January and February is the controlling factor, in the United Provinces at least. The information to be gained from the resistance of particular wheats in a bad rust year is therefore of absolute value; whereas that gained from resistance to rust induced by excessive irrigation may be only relative. This is one of the great reasons why a wheat cannot be with confidence accepted as rust resistant until it has been exposed to a year of bad disease.

Having obtained conditions favourable to the production of rust, the wheats must be graded according to the degree of their resistance to each of the common rusts. As this cannot be very rapidly done, and as it is essential that the grading should be completed in as short a time as possible, too large a number

of varieties is a disadvantage. About 250, however, can be fairly well graded in two or three days. It is essential that the grading should be done by someone conversant with the varieties of rust, but as the different stations do not get rust, usually, at quite the same time, one officer could do the grading at several places. I think grading should be done twice, once when rust is well established and once later on, as I have observed on several occasions that a late rust (usually *Puccinia graminis*) may become severe on a wheat which earlier in the season would have passed for lightly attacked. This second grading is of less importance than the first, and might be done by a Farm Assistant, as there is not the same need here to distinguish between the different rusts.

So far as the collection of good varieties true to seed and, in some cases, the production of new varieties by crossing promising sorts is concerned, a good deal of work has already been done, and I take it that several stations are now, or will soon be, in a position to commence grading their wheats. This part of the work has been entirely unattended to so far; indeed it could not have been attempted until the varieties of rusts in India were accurately known, that is, within the last year. I am confident, however, that it is an essential part of the work, for as long as a wheat is vaguely classified as resistant to rust, without any knowledge being obtained of what rust or rusts it is resistant to, a risk is run that, as soon as it is planted out in a place where it may have to withstand the attacks of a totally different rust from those it was previously exposed to, it may prove a failure. A wheat should not be approved of until it can be said that it ordinarily resists the rusts to which it is liable to be most exposed in a particular district. Nor should it be considered satisfactory until it has maintained its resistance through several seasons. I can myself or through one of my office staff, attend to the grading of any comparative series of wheats growing under rust-inducing conditions, as soon as they are ready for it.

The study of the pepper vine disease will be continued. The fungus suspected to be its cause has proved on culture to be identical to that which causes the wilt disease of arhar (*Cajanus indicus*). In the latter case inoculation has proved it to be the direct cause of the disease. In the former this is wanting, and as soon as the life history is fully worked out, I propose to depute one of my establishment to carry out inoculations either in Madras or Bombay. The same fungus appears to cause diseases of several other crops, and these it is hoped can be in part investigated during the year. The only chance, at present, of treating this class of disease is by the discovery of resistant sorts, just as with the wheat rusts. The search has been commenced in the case of arhar, and I hope may be taken in hand for pepper also, as soon as there is a station available for its study.

Treatment of oat smut with formaline and copper sulphate is being tested, and that of the two smuts of Juar common in India will be tried during the year.

Groundnut disease requires further work, which cannot be outlined until the results of this year's experiments are known. Assistance will probably be required in growing a plot in some district where the crop is not known, as I have got the disease into the Dehra plots to which some Poona soil was added this year.

The green ear disease of bajra, which is due to a new species of *Sclerospora*, and which is common in several provinces, will be studied, but is not likely to be fully worked out in the coming year.

It is not proposed to continue the investigation of spike disease in sandal trees in South India at present, as the disease is so obscure, and the failure of all inoculations tried has proved so puzzling, that it is evident that very extended observations and experiments are necessary before its cause can be elucidated. As this would mean the whole time work of a competent pathologist for at least several months, it will be necessary to wait for some time before it can be taken up again. Hasty visits of a few weeks' duration are not likely to be the least use, and the work cannot be done at a distance.

The coffee twig disease which has recently appeared in South India, first in the Nilgiris and later in the Neliampatties, is at present under treatment experimentally. The results of the different methods tried should be known in the coming year, and if successful, treatment can be extended.

The cause of the Casuarina disease in the Ganjam plantations has recently been ascertained, and attempts will be made to prevent its extension.

A rice disease known locally as "Chatra" has been reported from several parts of Bengal, and as the examination of specimens sent in has proved unsatisfactory, it is hoped to arrange for a local study in the coming year.

Work on sugarcane diseases will be continued particularly as regards treatment of redrot and smut. The Babul disease in Berar may require a local visit if it can be arranged for, as its mode of attack is doubtful. Arrangements will be made for keeping in touch with local officials so as to be informed early of any outbreak of disease.

It is proposed to depute a fieldman to one of the provinces to collect information and specimens of disease, and it is suggested that he should be attached temporarily to the local Department of Agriculture and placed under the general control of one of the local officers while reporting direct to me. If the experiment proves satisfactory, it will be possible later on to depute trained assistants from my office to the different provinces as opportunity arises to make local observations and carry on field work in connection with fungus diseases, and in particular to experiment, under direction from head-quarters, on the causation and treatment of certain diseases. At present trained assistants cannot be spared, and the fieldman's work will be limited to collecting and reporting on these diseases. I suggest sending him to Bombay, as there are several blights partly studied by me within the last two years in that Presidency, regarding which further information is required. Under present conditions this, and the continuance of touring, seem the chief means of keeping my office in close touch with the work of the Provincial Departments.

E. J. BUTLER,

Cryptogamic Botanist to the Government of India.

No. 670, dated Mozaffarpur, the 8th December 1904.

From—H. M. Lefroy, Esq., Entomologist to the Government of India,

To—The Inspector-General of Agriculture in India.

With reference to your letter No. C.-1497, dated the 15th ultimo, I have the honour to forward the note therein asked for.

2. I shall be glad to have an opportunity of explaining in further detail at the Conference the points I have raised.

3. I would suggest that the question of publication is an important one, and that the procedure to be adopted should be settled. A great mass of useful information lies in my office awaiting publication and, though I am not desirous of publishing in any hurry, it would facilitate the preparation of reports, etc., if I knew when and in what form the reports would be published. I have previously pointed out that some useful information on Economic Entomology is published in Annual Reports of Farms and other places where one would not look for it. I may instance Mr. Haymann's notes on cotton pests in the Annual Report of the Cawnpore Farm just issued. These should, in my opinion, be gathered in one publication available to every one and where every officer would look for such information. Such a publication I had hoped to have got in Indian Museum Notes, under the title of notes on Economic Entomology, but the transfer of that to the Department is not sanctioned, pending, I presume, the meeting of the Board at Pusa.

Note of the proposed Experiments at Pusa during the season 1904-05.

The work proposed to be carried out at Pusa includes two main features:—The investigation of such crop-pests as have not been worked out—the value of remedies against such pests as have been already studied and which will be found to occur at Pusa. In the first, it is expected that pests will be found which have not occurred in the past season in the Bombay Presidency; the pests of sugarcane and indigo may be specially mentioned, both being numerous and complicated.

In the second, an attempt will be made to deal with every pest for which remedies are already known; this is proposed both with a view to protecting crops and to determining how far and at what cost it is possible to check pests by means within the reach of the ordinary cultivator. This applies specially to the pests already studied, as well as those of ordinary kharif and rabi crops where they do not require protracted investigation. So far as possible the aim

will be to treat pests as would be done on a farm or private estate, determining in every case whether the treatment is fully paid for in increased yield. In addition there are the following enquiries: (*a*) the treatment of burrowing insects and white ants, (*b*) the value and scope of treatment with insecticides, (*c*) the use of light traps as indicators of approaching pests and as means of destroying flying insects, (*d*) the insect pests of cattle and domestic animals, (*e*) the value of trap plants, especially of maize and juari as a trap for moth-borer in sugarcane, and of bhinda for cotton pests, (*f*) the value of special means of increasing beneficial insects (parasites and predators) which prey upon common pests, and (*g*) the relation between plant vigour and immunity to special classes of pests.

As far as possible, these inquiries have been prepared for and to some extent commenced at Pusa during the present rabi season. Besides the erection of the Insectory, quarters, etc., the provision of areas of as many crops as possible on the Pusa Farm is the chief requirement necessary for research. In the case of the more important crops, (cane, cotton, rice, indigenous indigo, etc.) duplicate areas of the same variety treated in the same manner (in all except the treatment of pests), but grown at a distance from each other, are required to enable the effect of the treatment of pests to be more accurately discerned.

With reference to research experiments provided in the various provinces, it is hoped that co-operation can be arranged with regard to the testing of remedies already tried or believed to be useful; also in the general work of recording and identifying the injurious insects which are found in each province. The latter has been provided for in the case of two provinces and one State (Baroda) by the work of special assistants trained by the Entomologist, now working in their provinces under the general direction of the Entomologist. It is hoped it may be possible to train further men from other provinces, or to arrange equivalent methods of co-operation with regard to the actual determination of pests. The question of bringing the work at Pusa into closer touch with that of the Provincial Agriculture Departments depends, in some measure, upon the publication of information in a form useful to officers of Provincial Departments. The simplest measure would be to publish in a permanent form all information regarding pests studied in detail, and in a tentative form the result of the past season's investigations; the latter would include all experiments in the treatment of insect pests at Pusa and in all Provincial Departments whether carried out by the Entomologist or by Provincial Departments, and would be published as an "Occasional Bulletin" at the close of the year. This with the systematic recording of the actual pests of each province, would put every officer in touch with the results gained throughout India in the past season, and enable him to adopt such measures as he thought useful. An alternative is to publish in leaflet form all information thought likely to be of general use, indicating, specially, methods of treatment found useful at Pusa. Another enquiry which is in continual progress is the systematic survey of the Insect Fauna of India; this is a matter that is pushed on whenever the stress of other work permits. It is one of great importance both immediately and for the future, not the less so because its value is not immediately apparent, the co-operation of the staff of the Provincial Agriculture Departments would be of great advantage, and lead to more rapid progress both in the knowledge of Indian insects and in the identification of the insects sent to the Entomologist. The latter is at present almost an impossibility from the lack of large named collection of insects and no progress can be made in this matter till large collections have been formed.

A separate branch of work will be connected with sericulture, for which arrangements are being made. If possible, the question of Apiculture will also be considered and taken up.

H. MAXWELL LEFROY,
Entomologist to the Government of India.

MUZAFFERPUR,
The 8th December 1904.

Agricultural Experiments, Investigations, and Improvements to be carried out in Bengal during 1905-06.

No.	Name of crop.	Nature of experiment.	Where to be continued or attempted.	Remarks
1	Paddy . .	Variety experiment (generally fine or scented varieties with a common or coarse local variety as a standard of comparison.)	Burdwan, Dumraon, Cuttack, Chittagong, Gouripur (Mymensing), Rajshahi, Rungpur.	Six or so different varieties are being compared. Common varieties from different parts of Bengal to be compared together. The commonest variotios are generally the most prolific Outturn is generallly a far more important matter than quality, unless we get both combined in one. I would even go outside the country in search of good varieties.
2	„ . .	Manure experiment (comparison of cowdung, oilcakes, bonemeal, or nitre, by itself or in mixture with each other. Also green manuring with sunhemp, *thaincha*, etc.).	Burdwan, Dumraon, Cuttack, etc. (all the farms).	This experiment is more demonstrational than experimental. We make no attempt to discover whether nitrogen, phosphoric acid or potash is most required for paddy. We use only *general* manures rather to find out their economic value; we have got most important practical results.
3	„ .	Methods of cultivation— (*a*) Spacing experiment in transplantation of seedlings.	Burdwan, Dumraon, Cuttack, Chittagong, Rajshahi, Rungpur, and Gouripur.	The usual distance is 9″ or 10′, but sometimes, as in Backergauj more—15″ or 18″. Very encouraging results have already been obtained by increasing the distance from 9″ to 12″. The object of the experiment is to find out the best distance: 6′ to 18′ are being tried.
4	„ . .	(*b*) Number of seedlings per hole in transplantation.	All farms excepting Gouripur (Mymensing).	The experiment was suggested by the practice in Mymensing of planting one seedling per hole. In the rest of the province the number varies from 3 or 4 (Burdwan) to 10 or 12 (Chittagong) and even 15 or 20 (Shahabad).
5	„ . .	(*c*) Quantity of seed per acre in broadcasting.	Burdwan, Cuttack, Chittagong.	Only useful where broadcasting is much in vogue.
6	„ . .	(*d*) Washing roots of plants before transplantation.	Cuttack	The roots are usually washed.
7	„ . .	Two crops of paddy in the same year (or winter paddy after jute).	Burdwan, Cuttack . .	Two crops of paddy (winter paddy after autumn or autumn paddy or winter paddy after harvesting jute) are often taken off the same field in Chittagong, Rungpur, Mymensing, etc. It is only intended to introduce it where it is not known (with irrigation, if necessary).
8	„ . .	Irrigation experiments— (*a*) Irrigation *versus* no irrigation.	Do. . .	No irrigation in eastern or northern districts. Also some means of irrigation is recognized as absolutely necessary in South Behar. Hence the experiment is only made where it would be most useful.
9	„ . .	(*b*) Economy of water in irrigation.	Burdwan, Damradu, Cuttack.	Paddy being practically a water plant, it is not hurt by too much water, and the ryots take more than is necessary. The object of the experiment is to use different quantities of water a given number of times to find out how much is really necessary.
10	„ . .	(*c*) *Nigarh* versus no *Nigarh*	Domraon, Ramnagar (Ryots' field).	*Nigarh* is the practice in vogue in South Behar of draining the paddy fields from about 10th to 25th September. This accentuates the need for water immediately afterwards. The experiment is meant to see if *nigarh* may be dispensed with.
11	Wheat . .	Variety experiment . .	Dumraon, Cuttack, Rajshai, Rungpur, Gouripur, Siripur.	Suitable land is wanting at Burdwan.
12	„ . .	Manure experiment . .	Dumraon, Snipur . .	Little wheat is grown in Bengal proper or Orissa. So, outside Behar an attempt will be made to introduce the best variety. The question of the best way of manuring is not so important in these parts.
13	„ . .	Method of cultivation: deep and shallow ploughing (*New experiment*).	Do. . .	There is no room at Dumraon for any new experiments unless we give up some of the old ones
13-A	„ . .	Eradication of smut . .	Do. . .	By steeping in solution of copper sulphate or hot water, and also by sprinkling the seed with a stronger solution of copper sulphate. This is hardly an experiment as the absolute success of the process is beyond a doubt. It may be tried as a matter of demonstration. What is really wanted is to teach to it the ryots.

Agricultural Experiments, Investigations and Improvements to be carried out in Bengal during 1905-06—continued.

No.	Name of crop	Nature of experiment.	Where to be continued or attempted	Remarks.
14	Oats	Varieties	Dumraon, Cuttack, Rajshahi, Rungpur, Siripur.	
15	Jute	Do.	Burdwan, Rungpur, Jalpiguri, Faridpur, Gouripur (Mymensing, Rajshahi).	
16	„	Manure experiment	Burdwan, Rajshahi, Rungpur.	
17	„	Spacing experiment	Do.	
18	„	Harvesting at different stages of growth.	Do.	
19	Cotton	Variety experiment	Siripur, Dumraon, Cuttack, Chittagong, Rajshahi, Rungpur.	Egyptian, American, Sea Island, Broach, etc., also tree cotton.
20	„	Selection of the seed of indigenous varieties.	Saran, Muzaffarpur, Manbhoom and Cuttack.	It is proposed to select seed from the most prolific plants in these districts. The selected seed will be distributed among the ryots of the respective districts.
21	Sugarcane	Variety experiment	Burdwan, Dumraon, Siripur, Chittagong, Cuttack, Rajshahi, Rungpur.	Both Burdwan and Dumraon get water-logged in the rainy season.
22	„	Manure experiment (as in the case of paddy; see No. 2 above).	All farms.	
23	„	Methods of cultivation	Do.	
24	Potatoes	Variety experiment	Do.	We have very few good varieties in this country, but there is unfortunately great risk in importing new varieties from other countries as we may introduce various diseases. The matter is very important.
25	„	Manure (cowdung, oilcakes, superbonemeal, saltpetre, etc.)	Burdwan, Dumraon, Siripur, Cuttack, Rungpur, and Rajshahi.	
26	„	Cut *versus* whole pieces	Burdwan	Hardly a useful experiment. It has been clearly demonstrated both in our own farms and in other countries that the outturn is almost directly proportional to the quantity of seed planted.
27	Maize	Variety experiment (Jaunpur, Katunpong and Muzaffarpur, also Natal and American varieties).	Siripur, Dumraon, Cuttack, Rajshahi.	
28	Juar	Variety experiment (including fodder varieties).	Siripur and Dumraon.	
29	Bajri	Variety experiment (including bearded variety from Bombay).	Do.	
30	Tobacco	Variety experiment	Rungpur, Cuttack, Rajshahi, Chittagong, Siripur, Gouripur.	
31	Mustard	Do.	All farms	Cawnpur rape (bold yellow) sells in the Calcutta market for R3-10-0 to R3-14-0, when the local variety fetches only R3-4-0 or R3-5-0. But we don't know how this will succeed in our province.
32	Castor	Do.	Siripur, Dumraon, Cuttack, Rajshahi.	Coconada castor sells for R6, while local castor sells only for R3 in the Calcutta market. But we don't know if the former is suitable for our soil and climate, and what its outturn is as compared with that of the local variety. There are other varieties and it is desirable to compare them.

Agricultural Experiments, Investigations, and Improvements to be carried out in Bengal during 1905-06 —concluded.

No.	Name of crop	Nature of experiment.	Where to be continued or attempted	Remarks.
33	Rhea . .	...	Rungpur, Gouripur, Rajshahi, Chittagong.	There is a considerable export trade in rhea ribbons (crude bark) from China. The extraction of the fibre after degumming is beyond the ryots' power as it requires expensive machinery. But crude bark in the shape of ribbons may be made and will easily find a market. At present, however, we have no data upon which we may recommend its cultivation—the out-turn per acre or cost per maund, etc.
34	Turmeric . .	Varieties	Rungpur, Rajshahi, Chittagong.	Muslipatam variety sells in the Calcutta market for R4-12-0 to R5. Madras variety for R4 to R4-8-0, while Pubna variety, the best in Bengal, fetches only R3-2-0 to R3-4-0.
35	Ginger . .	Variety experiment . .	Rungpur, Rajshahi, Chittagong.	Same farms as for turmeric. Introduction of Cochin and Calicut varieties.
36	Chillies . .	Do. . .	Cuttack, Rajshahi, Rungpur and Chittagong.	
36A	Mulberry . .	Varieties manuring cultivation.	Rajshahi.	
37	Fodder . .	Varieties	Cuttack and Siripur, also Rajshahi.	
38	Do. . .	Ensilage	Siripur.	
39	Quick-growing fuel plants.	Varieties	Do.	Would be most useful at Dumraon also, but we have unfortunately no room.
40	Seed selection generally.	...	All farms. . . .	All the Farm Superintendents and Overseers should select seed from the most prolific and vigorous plants of every crop they grow, *but most of all of the commonest variety of paddy in their respective districts.*
41	Mixed crops as practised in Behar and regular rotation.	...	Siripur and Dumraon.	
42	Tobacco curing and cigar making.	...	Rungpur Industrial School .	The work to be placed in charge of an officer recently deputed to Burma for study of the operations.
43	Jute . .	...	Pemberanda, Durbhanga .	Bacteriology of steeping and retting, analysis of soil and water, experiments conducted by Mr. R. S. Finlow, B.Sc.
44	Indigo . .	...	...	(1) Improvement in manufacture, analysis of indigotin. Research regarding colouring matter in the plant, etc., at Pemberanda, Durbhanga, and afterwards at Sirsia, Muzaffarpur. (2) Seed farm at Dasna near Delhi—Natal—Java varieties, selection of seed, etc.
45	Irrigation .	...	...	Crop cutting experiments conducted by officers of the Agricultural Department and the Public Works Department on irrigated and unirrigated areas.
46	Veterinary Department.	...	Siripur and Pusa . .	Cattle breeding at Siripur and Pusa. Extension of the Belgachia College. Development of the subordinate veterinary service.
47	Fairs and exhibitions.	...	...	Demonstrations by travelling overseers of agricultural products, implements, etc.
48	Silk and Tussur.	...	...	Microscopical examination of seed, inquiries as to decline of the industries. Seed nurseries.

S. L. MADDOX,

15th December 1904. *Director of Land Records and Agriculture*

No. 66 C.—V-753, dated the 8th December 1904.

From—W. H. Moreland, Esq., I.C.S., Director of Land Records and Agriculture, United Provinces of Agra and Oudh,

To—The Inspector General of Agriculture in India.

I have the honour to submit the note asked for in your letter No. 1320 8—2, dated the 25th November 1904. I regret that the time allowed for its preparation has been too short to permit of my consulting the scientific officers of the Department, and probably one or two subjects have been treated inadequately in consequence, but in the circumstances this is unavoidable.

Note on Agricultural Experiments, investigations and improvements, in progress in the United Provinces.

Continuous investigations.

It is unnecessary to detail the field and laboratory investigations into certain fundamental questions, which have been conducted for some years and will continue for many years in future. Full information regarding them will be found in the Report on the Cawnpore Farm.

Study of crops.

The detailed study of individual crops continues. The study of juar (*Andropogon sorghum*) is in progress, and that of the poppy is being taken up.

Improvements in cropping.

The endeavours to improve the cropping in particular localities take the form of issues of good seed in places where the seed stock is known to be defective; the method adopted has been described in a recent circular of the Government of India, and need not be recapitulated. Cotton is now being added to the list of seeds dealt in as directed in that circular.

Search for varieties of crops for particular localities.

Investigations are also in progress to find suitable varieties of crops for localities where the local stock is bad, but nothing more suitable is known. The varieties now being sought for are (*a*) a rice for the canal-irrigated tracts of Bundelkhand; (*b*) a wheat for Bundelkhand generally. In this case new varieties are being produced by crossing in addition to the numerous existing strains under trial.

Application of water to land.

Investigations on the application of water to land are about to be taken up in accordance with the recommendations of the Irrigation Commission. The programme of these has not been settled in detail pending a decision as to the best means of measuring water flowing in very small channels—a point of considerable practical difficulty on which I should welcome any suggestions.

Destruction of kans-grass.

With these experiments may be coupled the attempt to kill kans-grass (*Saccharum spontaneum*) by prolonged flooding—also a recommendation of the Irrigation Commission.

Entomology.

The agricultural entomology of Cawnpore is gradually being worked out in detail under the Deputy Director.

Rust on wheat.

The investigation of rust on wheat is the joint-work of Dr. Butler and Mr. Hayman.

Utilisation of barren clays.

Attempts to utilise the heavy barren clays which (under the name of *usar*) are a prominent feature of the Provinces, continue on the lines laid down in the last chapter of Agricultural Ledger, XIII of 1901. It is unnecessary to recapitulate the details of the various experiments, not one of which is very promising.

Construction of percolation wells.

In well-sinking, the most important experiment is the sinking of percolation wells in places where the absence of a clay stratum makes spring-wells impossible. One experimental well has been sunk, and its value will be determined during the current season. Another type has been tried and found wanting and other modifications are being considered by Engineers.

Simplification of boring tools.

Attempts are also being made to devise cheaper and more rapid methods of taking borings, either to locate new wells or to tap lower springs for existing wells with inadequate supply. A common auger has been found to serve up to about seventy feet, provided no sand is met with, but it fails in sand; and a tool recently patented by Mr. Martin of Azamgarh is now under trial.

Improvement of the *tarai* water-supply.

The improvement of the water-supply in the sub-montane tract (known as the *tarai*) is now being out on a large scale. The shallow wells in this tract draw water from a stratum contaminated by decaying organic matter, and villages are not infrequently deserted owing to the sickness that results from the use of this water. The people object to tube-wells, so the existing wells are being re-modelled to prevent the ingress of water from contaminated strata, and to obtain a pure supply through pipes sunk to greater depths.

Sugar-manufacture.

The methods of sugar-manufacture pursued in the Rohilkhand tract have been under study for some years, and an adaptation of the indigenous method is being demonstrated in the locality concerned.

Cattle-breeding.

A depôt for rearing bulls has been established in the southern cattle-breeding tract of the Provinces, and plans for a depôt for the northern tract are now being worked out.

Subjects noted for discussion at Pusa in letter No. 1326—S-2, dated the 25th November 1904, from the Inspector General of Agriculture in India.

(*a*) Measures for bringing the Agricultural experts of the Imperial Department into closer touch with the work of the Provincial Departments.

I think the relations between the Imperial experts and the Provincial officers will be found to depend very largely on personal acquaintance, which can be secured by the tours of the former and by the regular meetings of the Board of Agriculture. The only additional measure I would suggest, is the organisation of an intelligence system, somewhat on the following lines. In the first place, the experts will doubtless have access to most of the literature dealing with their particular subjects, and they should habitually put this at the disposal of Provincial Departments. A monthly list of titles of important papers, books, etc., classified by subjects, should be circulated by the central department, and arrangements made to lend out publications from the central library to Provincial officers who require to see them. In the second place, there should be a quarterly journal where officers (Imperial and Provincial) could record the progress and results of their scientific work, and which would be open to free discussion by means of correspondence. It should be recognised by all officers that this journal has the first claims on their publications: and if this is done, the journal will, I think, have the most effective method of maintaining touch between officers who can seldom meet for personal discussion.

(*b*) Measures for regulating the work at the Pusa Research Station College, and Farm, so that it may be of the greatest use to the several Provinces.

I think the regulation of the work of Pusa must depend mainly on the Inspector General. He knows the needs of each province, and he is in the best position to say what are the problems of general interest that can best be tackled at the central station, and what are matters of more local concern that each province can work out on its own lines, with help, where needed, from the Imperial experts.

(*c*) Measures for bringing the work of the Provincial Agricultural Departments into closer touch with the agriculture of their provinces, so that it may affect the practices of the actual cultivators.

The conditions differ so greatly not only from province to province but from district to district, that I think it is entirely beyond the power of the Board to lay down any general scheme of measures. Each provincial department must work out this question for itself in accordance with local conditions.

In the United Provinces, societies (both provincial and district) are established failures, as the right type of member is not available in sufficient numbers, and the wrong type insists on joining. The activity of these societies is therefore galvanic and not vital. Attention has been concentrated of late on organising individual workers, a slow process but effective in course of time. Apparently, however, there will shortly be in existence a considerable number of co-operative societies formed for the organisation of credit and for other purposes; and where these societies develop, they will provide an entirely efficient means of communication between the department and the cultivators. Apart from these societies, the best hope for these provinces lies in educating the large landholders to take their place as pioneers of improvement. A scheme to secure this object has recently been brought forward by one of the leading landholders of Oudh, and is at present under discussion. For Demonstration Farms we must wait till Pusa is sending out qualified demonstrators.

I need hardly say that the foregoing remarks are not intended in any way as suggestions for other provinces, but merely as indicating the general lines of work adapted to this part of the country.

W. H. MORELAND.

No. 133 C., dated Lahore, the 7th December 1904.

From—W.C. Renour, Esq., I.C.S., Director of Land Records and Agriculture, Punjab.

To—The Inspector General of Agriculture in India.

In reply to your No. 1326— 8-3, dated the 25th November 1904, I have the honour to enclose the required note on the programme of the Agricultural Department of the Punjab for the year 1905.

Note describing generally the Agricultural Experiments, Investigations and Improvements which it is proposed to carry out in the Punjab in the year 1905.

1. The work of the Punjab Agricultural Department is on a modest scale. There is an Experimental Farm of 75 acres at Lyallpur, which will be extended to 150 acres next spring. One hundred acres will be utilized as a wheat and cotton-seed farm, and the rest will be for the ordinary manurial and variety experiments. Wheat is the staple crop of the Province. We have fixed on some varieties which are likely to do well in the Colony and south-west Punjab. These have been improved by selection. Muzaffarnagar and Delhi soft white wheats promise to be in demand. A hydraulic experiment with wheat has been arranged in consultation with the Irrigation Department.

2. Cotton claims even more attention than wheat owing to the wider scope for improvement. Our chief enterprise is connected with American varieties, both new and acclimatized. These were grown this year on 9 demonstration plots of 2 or 3 acres each in the Chenab and Jhelum Colonies, American methods being followed. The acclimatised varieties, including Dharwar, Cawnpur, and what is known as "Narma," all did well. There was no disease worth mentioning. The outturn will, it is anticipated, be at least equal to that of the most prolific *desi* varieties. Next year, acclimatised Americans will be grown on a commercial scale by 9 or 10 zamindars, and I hope to have some 500 acres of it. We shall gain further experience of the crop and go some distance towards solving the problem as to whether it can be grown at a profit. Mr. Mollison thought some average samples sent to him good enough to spin 40's. The word "Narma" requires some explanation. American Upland Cotton was distributed some 20 years ago to cultivators in various districts for trial. They did not take to the crop, but stray plants of American Cotton may still be found in their fields. In some instances, small patches of "Narma" are sown for home consumption. Newly introduced Americans are not as hardy as acclimatised, and are a little later in maturing It is intended to cross them with acclimatised plants. Selection from local

varieties has been begun. Some essays have been made with hybridisation, but expert advice is urgently required. Cotton-seed selection has been undertaken in five districts with a view to the improvement of the indigenous staples and to counteracting the deterioration due to the influence of ginning mills. This is being done by District Officers through the agency of cultivators who have shown an interest in cotton.

3. A 500 acre seed-farm has been established at Surgoda, for the new Jhelum Colony, mainly for good varieties of indigenous wheat and cotton.

4. An Agricultural Assistant trained by Mr. Maxwell Lefroy has begun work.

5. The usual manurial rotation and variety experiment call for no special remarks.

6. A Deputy Director will be appointed in the near future, and the Economic Botanist recently sanctioned for Saharanpur is for the joint advantage of the United Provinces and the Punjab.

7. In paragraph 2 (*a*) and (*b*) of the Inspector General of Agriculture's letter No. 1326—8-3, of the 25th November 1904, suggestions are invited as to measures for bringing the agricultural experts of the Imperial Department into closer touch with the work of the Provincial Departments, and for regulating the work at the Pusa Research Institute, College and Farm, so that it may be of the greatest use to the several Provinces. Our Agricultural Department being in its early stages, I regret that I am unable to make any definite proposals at present. I consider, however, that co-operation will be most essential. To secure this, I would give the superior Provincial Staff facilities for establishing intimate relations with the Pusa staff, for acquainting themselves on the spot with the resources of the Institute, and with the work which is being done there. The annual conference will go far towards providing the required opportunity. A Pusa magazine should record the progress of the various enquiries and experiments, and each Province might contribute notes. In special cases, members of the Pusa staff should be allowed to study particular problems on the spot. If this policy is pursued, Provincial Departments will know exactly what assistance they can get from Pusa, and will be anxious to avail themselves of it. I would deprecate the framing of any rules. These might frustrate their own object by creating an impression of subordination to Pusa.

8. In the Punjab we have not reached the stage at which District Agricultural Committees or Societies should be organised. The Deputy Director must get to know the language and the people. He must acquaint himself with the conditions of Punjab agriculture before we can embark with advantage on a definite policy. When we have decided on lines of improvement, I shall recommend the formation of District Agricultural Committees. Demonstrations will be arranged for wherever necessary, and the publication of a vernacular journal will be kept in view. Practical demonstrations with cotton are in progress. Courts of Wards will be able to give material assistance in many matters. Shows of agricultural produce and implements promise to be of use, and these could be managed by the District Committees.

W. C. RENOUF.

No. A-7412, dated Poona, the 28th November 1904.

From—H. S. LAWRENCE, Esq., I.C.S., Director of Land Records and Agriculture, Bombay,

To—The Chief Secretary to the Government of Bombay, Revenue Department.

With reference to Government Resolution No. 8017 of 19th October 1904, I have the honour to submit copies of notes prepared by Messrs. Fletcher, Knight and Gammie regarding experiments which are in progress and are under consideration for the coming year.

2. To these notes I may add that arrangements are being made for the expenditure of the grant of ₹10,000 in accordance with the scheme suggested by the Government of India on the collection of cotton-seed which will be distributed to cultivators at the next sowing season.

3. With reference to paragraphs 22 to 25 of Mr. Fletcher's note, I have the honour to observe that plans for the establishment of the farms therein noted are under consideration, but are not yet ready for submission to Government; it is not probable that these farms can be instituted in the coming year.

* * * * * *

NOTES REGARDING AGRICULTURAL EXPERIMENTS IN PROGRESS AND PROGRAMME OF WORK FOR THE COMING YEAR.

BOMBAY PRESIDENCY.

Farms in charge of the Deputy Director of Agriculture, Bombay.

Serial No. of farm.	Name of farm.	Name of nearest town or village.	Taluka in which situated.	District.	Area in acres.	Types of soil.	Date when established.
1	Surat	Surat	Chorasi	Southern Gujarat	84·0	Black cotton soil	1896.
2	Nadiad	Nadiad	Nadiad	Northern „	41·10	Sandy (Gorandu)	October 1903.
3	Dharwar	Dharwar	Dharwar	Karnatak	74·0	(*a*) Black clay, (*b*) Red-sandy soil.	April 1904.
4	Mirpurkhas	Mirpurkhas	Mirpurkhas	Sind	47·0	Light loam	September 1904.
5	Jalgaon	Jalgaon	Jalgaon	Khandesh	7·20	Black cotton soil	June 1904.
6	Chharodi	Chhárodi	Sanand	Northern Gujarat	6·0	Light loam	1902.
7	Daur	Daur	...	Sind	64·0	Sandy	Site selected.
8	Jamesabad	Jamesabad	Jamesabad	Do.	100·0	Heavy loam	
9	Sábarmati	Ahmedabad	Dascroi	Northern Gujarat	50 to 100	Light loam	Proposed.
10	Tapti	Mandvi	Southern Gujarat.	Southern „	100	Black cotton soil	
11	Movalia Tank	Dohad	Dohad	Panch Mahals	...	...	

2. The experiments to be conducted on each of these farms are in general so special to that farm that they are given under the heads of the farms separately. It might, however, be here mentioned that for the purpose of bringing home to the cultivators the results on any farm, it is intended, as a sufficient number of trained Assistants gradually becomes available, to establish round that farm small "out-post" demonstration plots. These will be itinerant and not stationary in character, the duration of any one "out-post" depending largely on the rapidity or otherwise with which the surrounding cultivators take up the improvement (either in seed or practice) demonstrated.

3. *Surat Farm.*—On this farm, as on almost all other farms, experiments will be made on the relative value of—

(*a*) *Crop rotations.*—Results up to date tend to prove that the agricultural practices of the district cannot be much improved on in this respect, a two-year rotation of cotton and juar (the latter as a sole crop or mixed with tur) giving a larger profit in general than any others.

(*b*) *Manures.*—Here again the correctness of the local practice of applying manure (farm-yard) only once every 5 to 7 years has been proved by experiments which have been already conducted for a series of years. Experiments made during the current season on a number of artificial manures will be continued during the next few years.

(*c*) *Selected and unselected seed, especially of cotton and juar.*—Definite results have already been obtained with regard to the latter crop, but almost all the improved seed will be lost this season owing to the unfavourable monsoon. Selection will be continued in the case of these and all other crops grown in the district.

(*d*) *Imported varieties of several crops, especially groundnut, wheat, and juar.*—Will be further tested as to their suitability for growth in the district. As far as experiments have gone, Virginian and large Japanese groundnuts alone show definite superiority over the local varieties.

(*e*) *Hybridization.*—In the course of the next season definite results may be looked for from the hybrid cottons selected during the current

year. As far, however, as improvement in Surat cotton is concerned, the set of hybrids initiated during the last and the current season will probably give the best results in the long run, and this type can only be fixed after another three years' selection. Hybridization with wheat, rice, etc., will be continued.

(*f*) *Insecticides and fungicides.*—Experiments on these lines (the former under the control of the Entomologist to the Government of India) will be continued. More is, however, here to be expected except in the case of "smut" on cereals from the production by selection of resistant varieties.

(*g*) *New agricultural implements.*—For the garden cultivation in the neighbourhood, English turn-wrest ploughs are in great request and these are imported and distributed to cultivators at cost price. Other new implements including one or two for raising water to a height of three or four feet will be set up, as the needs of district in this direction become known.

4. *Botanical work* on the farm will include the determination of the botanical affinities of the cottons of the world and of Indian varieties of juar, wheat, etc.

5. *Nadiad Farm.*—The farm is intended in the first case for the improvement of the cultivation of tobacco in the district. Experiments as to the rotations and manures, under which this crop gives the largest yield, will be conducted. Until a curing house is erected little can be done in the direction of obtaining a better quality of leaf for export.

6. Experiments under the various heads given above for the Surat Farm will be conducted on the staple crops of the district, which include (besides tobacco)) bajri, kodra, nagli, juar, etc.

7. Owing largely to prevalance of plague and partly to bad seasons, the price of tobacco has decreased greatly since the famine. The former cause is responsible for the fact that dealers will not visit the district, and the latter that the quality of tobacco produced is inferior. In consequence, many cultivators are subsituting the cultivation of cotton for that of tobacco ; this tendency to change is also aggravated by the enormous profits obtained from cotton during the past season owing to manipulation of the material in America. It appears, then, that the cultivation of cotton should find a place on the farm.

8. *Dharwar Farm.*—On this farm experiments will be undertaken under all the heads detailed above for the case of the Surat Farm.

9. This district is probably the only part of the Presidency where exotic cotton can be grown on rainfall alone. One of the directions experiments will take is the acclimatization *de novo* and hybridization of American cotton. It would appear that in previous experiments to this end no systematic attempt has been made to find the exact period at which sowing should take place. At present the acclimatized American is sown at the end of August or beginning of September and flowers in December. This is probaly at least a month too late, and during the current year the effect of earlier sowing is being tested, and up to date promises to be most beneficial.

10. *Mirpurkhas Farm (Sind).*—Here the crops to be experimented on will be quite different in general from those in the Presidency proper, though the headings given under the Surat Farm will still apply.

11. *Egyptian and American cottons* have been sown during the current year at Dhoro Naro, and though the conditions as to water-supply, time at which sowing could be commenced, character of season, etc., were far from favourable, it is expected that the results obtained will justify an extended trial under the better water-supply (perennial) obtainable on the Jamrao Canal at Mirpurkhas. During the coming season it is also intended to distribute to zamindars seed sufficient for sowing about 500 acres. Seed much in excess of this quantity has already been asked for by zamindars, but it is thought that until further experiments prove which is the best variety of those tried, the area put under the crop by zamindars should not be too great.

12. Besides these crops, others (especially Egyptian) will be tried including several leguminous varieties. The latter are of special importance in this case, since complaints are rife that the land on the Jamrao has thus early become exhausted. Two such crops are Egyptian clover and groundnuts (see paragraph 211).

13. *Sugarcane.*—Will be experimented on here if, as suggested by me, the period during which, owing to canal clearance, no water is available is changed from April-May to December-January.

14. *Maize* is another crop to which special attention will be given, as the varieties at present grown in Sind are very inferior.

15. One of the chief lines of work in this rainless tract will be the conduct of experiments as to the relative value of water when applied to various crops. These experiments will be initiated as soon as funds are forthcoming for the erection of the stone-work necessary for the measurement of the water; this, it is hoped, will be within the current year.

16. Under the newly introduced perennial water-supply of the Jamrao Canal over-irrigation is very common, and large areas under this canal have already become salt and passed out of cultivation through this practice. It is intended to experiment on such land in the neighbourhood of the farm.

17. Under the head of "New implements" may be particularized (*a*) "Water-lifts" which in Sind, especially on low lifts, can undoubtedly be much improved, (*b*) the modification of the native plough for the purpose of making ridges for crops (at present unknown in Sind), (*c*) an implement for making the ridges that are necessary under irrigation for the purpose of dividing the land into blocks, each of, say, an area of 5 guntas (also unknown at present in the province), etc., etc.

18. *Jalgaon Farm.*—At present this temporary farm (7 acres 20 guntas in extent) grows only cotton-hybrids and superior varieties of juar. The former are crosses between Khandesh cotton and finer growths. Last year there were indications that an improved variety suited to conditions in Khandesh might be looked for in the course of the present season. If this hope is justified by results, the establishment of a larger permanent farm will be necessitated by the larger scale on which cotton-breeding should be conducted. As Khandesh is a large cotton-growing district and as it is absolutely necessary that, for purposes of improvement in staple and yield, each cotton variety should be manipulated in its own particular district, it is almost certain that very valuable results would, under these circumstances, be obtained.

19. In the event of a larger and permanent farm being established, experiments under all the heads detailed in the case of the Surat Farm will be conducted.

20. *Chharodi Farm.*—Work on this small plot will be confined for the present to the cultivation and selection of the very promising cotton-hybrids already obtained between the local variety and finer growths. Until the district has more completely recovered from the effect of the last famine, it seems doubtful whether experiments in other directions would have any immediate result.

21. *Daur Farm.*—A site comprising 61 acres of very sandy land has been chosen on the Nasrat Canal. The farm is intended chiefly for experiments in the cultivation of groundnuts—a crop at present practically unknown in Sind—though other crops suited for growth on sandy land will also be experimented on. At present work has not yet commenced owing to lack of the necessary subordinates to be put in charge.

22. *Jamesabad Farm.*—This farm will be supplementary to the Mirpurkhas Farm. The soil is slightly heavier and will therefore require different treatment in the way of irrigation. The land like much of that in the neighbourhood is not cultivated owing to the fact that it is impregnated with salt. For the first year or two experiments in the reclamation of the site will, it is hoped, prove valuable, as the question of the proper treatment of such land is of very pressing importance not only in Sind but in all parts of India, where perennial irrigation is practised.

23. *Sabarmati Farm.*—It is intended to acquire a site for an experimental farm on land to be commanded by the proposed Sabarmati Canal. Experiments similar to those on the Mirpurkhas Farm will be here conducted. It is probable that if the water-supply is good much more valuable varieties of crops can be grown than is now the case in the district. The date of the establishment of this farm will naturally depend on the date when the proposed canal begins to operate.

24. *Tapti Farm.*—It is proposed to select a small area on the banks of the Tapti beyond tidal influence to experiment on the effect of irrigation on black

cotton soil. For this purpose a small oil-engine with a rotatory pump will be necessary for raising water.

25. *Movalia Farm.*—The site for a farm has been selected under the newly completed Movalia Tank in the Panch Mahals. The remarks made in the case of the Mirpurkhas Farm apply also here.

26. Finally, reliable results on these farms would be much accelerated if the Department possesses a good Agricultural Chemist and Mycologist. Many questions have already arisen on which much light would be thrown and in, which direction experiments in the field should take would be indicated by the laboratory work of such officers. Their appointment and the erection and fitting up of their respective laboratories, is a matter of great urgency.

F. FLETCHER,
Deputy Director of Agriculture.

The experimental work under the charge of the Special Assistant to the Director of Agriculture.

Serial No of farm.	Name of farm.	Name of nearest town or village	Taluka in which situated.	District.	Area in acres.	Types of soil.	Date when established.	Remarks.
1	Poona Farm	Poona	Haveli	Poona	28·0	Medium black and light soil.	1879	
2	Dairy Farm	Do.	Do.	Do.	332 22	...	1890	
3	Manjri Farm	Hadapsar	Do.	Do.	62·31	Deep black and light soil.	1894	
4	Manjri Sewage	Do.	Do.	Do.	15 0	Black and light soil.	1901	
5	Rice experiments at Lonavla.	Lonavla	Mawal	Do.	10·1	Light soil.	1903	
6	Rice and juar plots, Wadgaon.	Wadgaon	Do.	Do.	1·32	Do.	1904	In cultivators fields.
7	Chowk	Karjat	Karjat	Kolaba	3 6	Do.	1903	
8	Thana	Thana	Salsette.	Thana	2 2	Do.	1903	
9	Nira	Nira	Bhimthadi	Poona	...	...	Proprosed.	

The work at these various centres is varied and will be treated of one by one.

2. *Poona Farm.*—This farm serves the purpose of practical teaching in agriculture to the agricultural students at the College of Science, and for this reason only serves to a limited extent the purpose of experimentation.

3. The principal lines of experiment have been the study of the varieties of indigenous crops of India for the purpose of the identification, classification, and determination of the peculiarities of the several varieties. Along this line the study of cotton, juar, millets, pulses, wheat, rice, maize, and bajri has been undertaken. The assistance of Professor Gammie, Professor of Botany, College of Science, Poona, has been freely availed of in the above work, and wheat and cotton have been quite thoroughly worked out. Rice, tur, juar, and the pulses are receiving attention at present. This work will go on in the coming year.

4. The effect of climate upon the variety is being made a matter of study here with cotton and wheat. All varieties are being grown continuously at the farm and compared each year with crops of the same variety raised from seed brought direct from the home of that variety.

5. The hybridization of cotton, as inaugurated by Mr. Mollison, will only be carried on at Poona, so far as it may be needed to give some clue to the origin of varieties from the behaviour of the hybrids. The hybridization of wheat will be continued with a view of discovering a rust-proof variety of superior quality. Also hybridization among other crops will be attempted.

6. The selection of seed from the object plots, in which are grown many varieties of most of the crops of the Bombay Presidency, is carried on incidentally.

Imported varieties will be tried as they are received.

7. *Poona Dairy Farm.*—This farm is devoted to the growing of fodder for its animals, and as far as posible comparative trials are made with the various fodder plants available, especially fodders of the order *leguminosæ*. The land is kept continuously under crops, and manure, rotation, and irrigation in such case require great care.

8. The dairy consists of about 250 animals, composed of representatives of three breeds of cows, *viz.*, Sind, Gir, and Aden, and three breeds of buffaloes, *viz.*,

Delhi, Jaffarabad, and Gujarat. A record is kept of each animal and a comparative test of the profits of these six breeds is being made.

9. Scientific breeding is almost unknown in the case of Indian cattle. In the breeding of the animals of these several breeds at Poona, it is proposed to demonstrate the value of scientific principles of breeding dairy cattle. It is believed that in a few generations the Indian dairy cow or buffalo could become so improved that she will compare favourably with the European diary animal.

10. The food tests will be made from time to time to ascertain the most economical methods of feeding for milk.

Experiments in treating of butter for keeping and tinning will be tried.

11. *Manjri Farm* was established for the investigation of sugarcane cultivation.

Manure experiments will be carried on as follows :—

(1) To verify the results of previous years with oil-cakes, poudrette, and nitrates.

(2) To ascertain the nitrogen requirements of the hard varieties of cane (Vansi and Sannabile).

(3) To ascertain the potash and phosphoric acid requirements of sugarcane in their region.

(4) Rotation experiments for sugarcane are to be tried to ascertain the most profitable rotation for this crop under the block system of irrigation.

12. Further tests of the best varieties of juar, bajri, wheat , groundnut sweet-potatoes adapted to Poona District will be carried on.

13. As regards tapioca, the outturn of the crop, percentage of starch, feeding value, danger of feeding, and ability to resist drought will be considered and determined.

14. Experiments with insecticides and fungicides are made as occasion arises.

15. Experiments for finding out through the plants the manurial requirements of the soil of this region will be carried on.

The careful selection of seed of all crops will go on at this farm.

16, *Manjri Sewage Farm.*—The Municipal Sewage Farm of the City of Poona is located near Manjri Farm. Here sugarcane and garden crops are grown under sewage that has been through the septic tank. The objects are (1) to find the manurial value of the sewage, (2) to find the best treatment needed for its purification, and (3) to find out the area of land required to take the sewage from a given population. It is felt that when the results of the year are available questions (1) and (3) will be fully settled, and if further experiments are to be made, sewage from an area of Poona actully drained should be applied.

17. *Rice Experiments at Lonavla.*—A small area of rice land has been leased for the year at Lonavla and work is going on on the following lines:— (i) Rab experiments to ascertain (*a*) wherein lies the benefit of this system of cultivation, (*b*) to ascertain the comparative value of several rabs in use, and (*c*) to find a substitute ; (ii) a comparative trial of rice varieties; (iii) experiments with nitre as rice manure. The results are not yet available, but such work will require several years.

18. *Nitre experiments.*—The value of nitre on rice soils of somewhat retentive nature was fairly well demonstrated last year. Experiments of this year, judged from the standing crop, confirm the results of last year.

19. *Another line of work.*—It is proposed to carry out experiments for reclaiming the water-logged and reh lands on the Nira Canal.

J. B. KNIGHT,
Special Assistant.

Experiments proposed to be carried out in the Ganeshkhind Botanical Garden.

1. A systematic collection of indigenous trees and shrubs to determine (among others) the following facts :—

(i) the most satisfactory methods of reproduction, tansplanting, and treatment during growth ;

(ii) the periodical increment of growth ;

(iii) periods of leafing, flowering, fruiting, and ripening of seed;
(iv) age at maturity;
(v) special investigations regarding the quality of timber, yield of other economic products, etc.

2. Experimental introduction of rubber, fibre, medicinal plants, etc.

3. Experimental tests on exotic plants on the same lines as (1) and (2).

4. Endeavours to improve and increase the yield of fruit trees, indigenous and also exotic, if found suitable for the Deccan.

5. Botanical research in special natural orders, the first three to be undertaken being Malvaceæ, Leguminosæ, and Cucurbitaceæ.

6. To continue the cultivation of cottons for purposes of botanical classification, also of wheat and rice.

7. To attempt the improvement of a selected number of our finest wild flowering plants so that they can be used as garden plants.

G. A. GAMMIE,
Professor of Botany, Poona.

Proceedings of the Board of Revenue (Revenue Settlement, Land Records, and Agriculture), Madras, and 6690 Miscellaneous, dated the 8th December 1904.

READ—

Letter from the Deputy Director of Agriculture, No. 1562, dated the 21st October 1904, submitting, with remarks, a memorandum on the experimental work to be carried out by the Department during 1905-06, and suggesting that the Board of Agriculture might be asked to consider what general line of policy is advisable.

Read also—

Letter from the Government Botanist, No. 1174, dated the 30th October 1904, submitting memorandum of the agricultural investigations, experiments, and improvements proposed to be conducted in the Government Botanist's office during the ensuing season.

Read also—

Letter from the Inspector General of Agriculture, No. C-1502, dated the 16th November 1904.

Read also—

Letter from the Inspector General of Agriculture, No. 1326—8-6, dated the 25th November 1904.

Read also—

Letter from the Superintendent, Civil Veterinary Department, Madras, Dis. No. 987, dated the 3rd December 1904, submitting that the agricultural experiments, investigations, etc., are outside the work of his Department.

RESOLUTION.—With reference to his letters Nos. C-1502, dated the 16th November 1904, and 1326—8-6, dated the 25th November 1904, a note describing the agricultural investigations, experiments, and improvements, which it is proposed to carry out during the ensuing season in this Presidency, and containing certain proposals in regard to the subjects mentioned in paragraph 2 of the latter letter is herewith forwarded to the Inspector General of Agriculture.

2. Adverting to his letter No. 1343, dated the 27th November 1904, the Inspector General is informed that owing to the present state of the season Government are unable to spare the Director to attend the first meeting of the Board of Agriculture, but that the Deputy Director of Agriculture (Mr. C. Benson) and the Government Botanist (Mr. Barber) will be deputed from this Presidency. They have been instructed to reach Pusa on the 5th January 1905.

Note describing the Agricultural Experiments, Investigations and Improvements, which it is proposed to carry out in 1905 in the Madras Presidency.

SECTION I.—INVESTIGATIONS.

(i) Systematic Botanical Survey.

(*a*) The Government Botanist will make a special study of the forests of the Western Ghats in Travancore and will collect specimens of the flora thereof for his herbarium.

(*b*) The study of the *haustoria* of the sandal will be continued. As the sandal of Madras is stated to be inferior to that of Mysore in oil-bearing properties, a biological study of the flora of the sandal tracts in Mysore will be made in order to determine, if possible, the effect of associates upon the production of scented wood.

(*c*) The attempt to determine the species, with their vernacular names, of the forest trees of the coffee zone in Mysore will be continued. The work may be of use in the investigation of stumprot in coffee.

(*d*) Collections of the various *Loranthaceæ* (parasites), which are ravaging the forests of this Presidency, will be made, and their biology studied.

(*e*) A careful study of the wild peppers of this Presidency has been commenced and will be continued, as it is necessary both from a scientific and the economical point of view.

(*f*) The grasses of this Presidency, of which large collections have been made, will be examined and named.

(ii) Economic Survey.

(*a*) The economic survey of the cultivated plants of Madras will be pushed on with.

(*b*) Information as to the uses to which agave plants are put and the methods of extraction of fibre adopted in the different districts will be collected.

(*c*) A careful study of the cottons grown in this Presidency will be made in the light of Middleton's and Gammie's Classification, and similar work carried on in regard to cholams, indigos, sugarcanes and other valuable crops.

(iii) Studies in Practical Agriculture.

A detailed study will be made of the crops and agricultural conditions of the Malabar and South Arcot districts, if Government sanction the establishment of pepper and groundnut farms in these districts, in regard to which proposals have been made. Otherwise, the Deccan districts will be taken up.

(iv) The investigation of *fungoid disease* and *insect pests* affecting plants of economic importance—will be made as far as possible.

SECTION II—EXPERIMENTS AND IMPROVEMENTS.

(i) In respect of particular agricultural practices.

(*a*) The experiments in progress at the Bellary and Koilpatti farms in regard to the value of deep tillage as a remedy for the evil effects of drought will be continued.

(*b*) Cattle manure will be collected under the loose box, byre and the ordinary local methods, and their value will be tested in comparative plots.

(ii) In respect of particular crops or classes of crops or soil.

(*a*) *Cotton.*—The study of the local varieties of cotton will be proceeded with at the Bellary and Koilpatti farms, and steps taken to improve the quality and outturn of the specially valued sorts by selection and, to a limited degree, by cross-breeding.

A further field-study will be made of the cottons grown in the Deccan districts and Guntur and of the ukkam and uppam crop grown in Coimbatore, Madura and Tinnevelly, and the seeds of the most valuable varieties selected

for further cultural operations either on Government farms or by selected ryots under the advice and supervision of the Deputy Director.

With reference to paragraphs 7 to 9 of the letter from the Government of India, No. 23—9-36, dated the 16th September 1904, steps will be taken to select and supply good cotton seed to cultivators.

Some American cottons will be grown at the Bellary farm, to test their fitness for cultivation, as field crops on cotton soil, and at Koilpatti, to see whether they can be grown on the lighter soils.

Under the Government Botanist's supervision, light soil cottons, American varieties, etc., will be grown at Saidapet. and perennial tree cottons planted to obtain good herbarium specimens for the Inspector-General of Agriculture. The cultivation of a few other varieties for more careful botanical study than can be made at Bellary and Koilpatti will be continued.

(*b*) Experiments in seed selection will be made in the case of *sorghum*, *korra* and *ragi* at the Bellary farm and in regard to *kambu* at the Koilpatti Farm; and *ragi* will continue to be grown at the latter farm under the ridge-and-farrow and flat-bed systems for testing relative outturns. A number of varieties of fodder *sorghums* and of *cumbu* obtained from Bombay will be sown at the Bellary and Koilpatti Farms, and the cultivation of different varieties of the *irungu sorghum* of the south will be continued at Koilpatti in order to study their peculiarities and to improve such sorts as promise well. Experiments will also be made for determining when fodder *sorghum* can be cut so as to obtain the best results.

(*c*) *Sugarcane.*—The experiments at the Samalkota Farm will be continued. A large number of varieties of seed-cane, both indigenous and imported, are being tested to obtain healthy canes suited to the condition of the Godavari district, and to determine the comparative values of various manures, local and specially made, and of different methods of cane cultivation. Attention is being directed to the question of drainage and of increasing the efficiency and diminishing the cost of weeding and working the land. The chemical analysis of the more important canes will be continued in order to determine their true ripening age under the Godavari conditions: the local jaggery making will be examined in view to improvement, and experiments will be made in draining the jaggery, rapid boiling and sufficient liming, after the practice followed in the Philippines; the subject of ratooning will be investigated to discover the quantity of manure needed and to test the advantage of making separate trenches each year, burying the trash in the previous year's trench. Experiments will also be made in order to improve the condition of the soil at the farm so as to make it suitable for the application of chemical manures and to save the canes from being swamped from October to February and thus prevent their being attacked with disease. A "disease plot" has also been started with the object of raising disease-resisting varieties from among the valuable but delicate and diseased canes of the district.

(*d*) *Tobacco.*—Tobacco of five varieties will be grown in the Koilpatti Farm and a commencement will be made in devising a better method of curing than prevails locally.

The existing methods of growing tobacco around Dindigul will be studied and some experiments carried out in the curing of the leaf with the assistance of a local firm of cigar manufacturers.

(*e*) *Paddy.*—Three varieties of paddy, which are capable of maturing rapidly and can therefore be grown in places where the rainfall is moderate, will be propagated in the Koilpatti Farm.

A quick-growing paddy from Tanjore will be planted at the Samalkota Farm to see whether four crops can be reaped in a year.

Paddy seed will be obtained from Burma and grown on lands liable to submersion by the Kolair in the Bhimavaram Taluk, Kistna District.

Further, the experiments already made in the Agricultural College, Saidapet, and at Shiyali, Tanjore District, with certain varieties of paddy received from the Inspector-General of Agriculture will be continued.

(*f*) *Paspalum dilatatum.*—Efforts will be made to propagate this valuable fodder grass at the Bellary, Koilpatti and Samalkota Farms.

(*g*) The agave plantation at Hindpur will continue to be worked.

(*h*) To promote the cultivation of a second crop on paddy lands under the Rushikulya Project in the Ganjam District, the Executive Engineer will grow Sconi wheat and Egyptian clover or Berseem.

(*i*) Experiments in the cultivation of irrigated dry crops on black cotton soil will be made under a new work in the Nellore District through the agency of ryots to prevent the land becoming water-logged; a spraying apparatus has been devised by the Sub-Assistant Director, and it will be tried both in that district and at the Bellary Farm. In the event of Government sanctioning the establishment of a pumping station on the banks of the Hagari, experiments regarding the best way of utilising water on black cotton land and the feasibility of growing garden crops and irrigated cotton therein will be prosecuted there.

(*j*) Experiments in the reclamation of alkaline land in the village of Terkuteruvu, Madura District, will be continued; and an effort will be made to propagate Berseem (Egyptian clover) seed at the Bellary Farm, the plant being reported to be suitable for growth on alkali land.

(*k*) The seed drills which are used in the Deccan districts and which are unknown in the Godavri District will be tried at the Samalkota Farm for sowing red gram, dry paddy, *cumbu*, castor and other small seeded plants. Improved ploughs will be tried at the Koilpatti Farm.

(*l*) If the Board's proposal to start a combined *groundnut, sugarcane and indigo farm in the South Arcot District* is sanctioned by Government, experiments will be made in the undermentioned directions:—

(1) *Groundnut.*—Testing all useful varieties, both indigenous and foreign in order to discover the best disease-resisting varieties and the remedies to be applied for the eradication of the several diseases.
(2) Testing the value of the various manures that can be applied for preventing the exhaustion of the soil incidental to the continuous growth of groundnut on the same land;
(3) Testing the comparative values of different modes of working the soil and planting the seed;
(4) Determining the relative value of the groundnut crops grown on wet and dry lands with and without the aid of irrigation;
(5) *Sugarcane.*—Introducing varieties of canes superior to the white reed cane which is chiefly grown in the district at present;
(6) *Indigo.*—Promoting the growth of indigo by ryots by ascertaining whether, with increased care in cultivation and the importation of new varieties, a better yield cannot be obtained and a better product secured than is the case at present;
(7) Studying the mode of manufacture of indigo and the relative values of irrigated and rain-fed indigo.

(*m*) In the event of Government sanctioning the proposal to establish *a pepper farm in the Malabar District*, all the existing wild peppers will be examined; special attention will be devoted to the distribution of the sexes; the disease affecting the pepper plantations will be investigated, and efforts made to raise resistent varieties as is at present done in the Samalkota Farm in the case of sugarcane. All the questions relating to manures and the methods of cultivation will be studied, together with the proper standards on which to grow the plants.

(iii).—Improvements in matters connected with agriculture.

(*a*) Preventive inoculation of cattle will be vigorously continued; and new Veterinary Assistants will be entertained, and Veterinary Dispensaries opened, as funds permit.

(*b*) To promote a general improvement of stock, selected bulls will be supplied to the most suitable breeders in congenial localities in the neighbourhood of the breeding districts.

(*c*) Cattle will be fed on a small scale with sunn-hemp to see whether it is a beneficial or harmful feed for cattle.

Questions referred to the Board of Revenue in paragraph 2 of the Inspector-General's letter No. 1326—8-6, dated the 25th November 1904.

(*a*) The Entomologist to the Government of India has agreed to take apprentices from this Presidency for training in Entomology. It seems desirable that the other agricultural experts of the Imperial Department should also train apprentices sent from the Provinces. Again, neither the Imperial Entomologist nor the Imperial Cryptogamic Botanist has furnished any report on the results of his visits to this Presidency. They as well as the other experts of the Imperial Department should be instructed to submit reports on the results of their investigations to the heads of the Local Department of Agriculture as soon as possible, after they have completed their tours.

(*b*) The scheme of work proposed to be done at the Pusa Research Station, College Revenue and Farm as set forth in the Resolution of the Government of India, Department of Revenue and Agriculture (Agriculture) to the Secretary to the Government of Madras, Revenue Department, dated the 29th February 1904, No. 8, seems so admirably adopted to meet general agricultural requirements, that in the absence of more detailed information on the subject, the Director is unable to suggest how that work might be regulated so as to be of the greatest use to this Presidency. The chief want here, as in other Provinces, is a body of scientifically trained practical Indian agriculturists, and this want seems likely to be gradually supplied by Pusa.

(*c*) Among the more important measures for bringing the work of the Provincial Agricultural Departments into closer touch with the agriculture of their Province, so that it may affect the practices of the actual cultivators, may be mentioned the following :—

The selection and distribution of good seeds of cotton and of the more important crops grown at the experimental farms to ryots who are freely allowed to visit the experimental farms, where qualified subordinates of the Agricultural Department are deputed to explain and show them the improved methods adopted at the Government farms or elsewhere and the results attained at the farms where possible. Ryots should also be associated with experimental farms by using them as agents in particular experiments conducted on their own lands under expert advice. The officers of the Agricultural Department should confer with ryots frequently in the course of their tours. Advice and information on all matters of agricultural interest to ryots should as now be conveyed either in the village sheets of the District Gazette or by means of pamphlets or leaflets. Bulletins recording the results of the work of the Agricultural Department should also as now be published. In this Presidency, Agricultural Associations have been formed in many districts and the Local Department should, as now, do all in its power to assist them to improve local agricultural practices.

V. K. RAMANUJACHARI,
Secretary.

No. 6566-I., dated the 15th December 1904.

From—B. P. STANDEN, Esq., I.C.S., C.I.E., Commissioner of Settlements and Agriculture, Central Provinces,

To—The Inspector-General of Agriculture in India.

In reply to your letter No. 1326-85, dated the 25th November 1904, I have the honour to forward a copy of the Programme of the Provincial Department of Agriculture for the current year, and to say that the Programme for the coming year will be on the same lines with some minor alterations and additions, of which the most important perhaps are: the initiation of irrigation experiments on the three Experimental Farms, the Government guarantee of private cotton seed farms, the distribution of selected cotton seed now being collected, and the allotment of a small sum to the District Agricultural Associations through the Governing Body of the Victoria Technical institute with the object indicated in the extract from my letter No. 6551, dated the 14th instant, to the Chief Secretary to the Hon'ble the Chief Commissioner, of which copy is attached. The Budget of this Department for 1905-1906 includes Rs. 5,000 as a

grant to the Victoria Technical Institute, to be allotted to the District Agricultural and Industrial Associations, and Rs. 2,000 on account of the guarantee, against loss, to be given to cotton seed farms.

Extract paragraphs 9, 10, from letter No. 6551, dated the 14th December 1904, from B. P. Standen, Esq., I.C.S., C.I.E., Commissioner of Settlements and Agriculture, Central Provinces, to the Chief Secretary to the Honourable the Chief Commissioner, Revenue Department, Central Provinces.

* * * *

9. District Agricultural and Industrial Associations have been established in all districts on the lines described by Mr. Sly in his Circular letter No. 3556-23 of 5th August 1902, to the Deputy Commissioners. The work of the Associations has been confined to the trial by the members of some of the improvements recommended by the Department and to report and discussion of the results at meetings. Some of the new crops and methods brought to their notice have met with their approval, but they are scarcely yet in a position to exert any appreciable influence on the cultivation of their neighbours. I do not think they are now in the best position to effect this. Most of the improvements recommended entail some initial expenditure. The members of the Associations are generally well-to-do men who do not grudge the few rupees which must be spent to enable them to form their own opinion on the particular novelty offered for their consideration. It is not to be expected that they should lay out their own money in efforts to induce their poorer neighbours to try innovations which they have tested and approved. At the same time much progress cannot be expected, unless the first steps are made easy for the rank and file. I would, therefore, advocate the allotment to the District Associations of small sums to be used for this purpose. It was evidently contemplated that this should be done, *vide* paragraph 2 of Mr. Sly's letter referred to above, in which he writes: "funds will be provided by the Department of Agriculture and the Victoria Institute for any experimental work approved by them." Money could be usefully spent in all districts on the provision of a stock of seed selected on some easily practised method, in villages where sugarcane and other garden crops are largely grown: in digging the pits necessary for the proper conservation of manure: in the northern districts in providing stock of the implements required for the cultivation of cotton and juar in the Nagpur fashion and perhaps on the wages of a ploughman to teach their use: in weaving centres in setting up a small workshop in which the fly-shuttle loom would be used by paid employés, with the object of demonstrating to the master weavers the advantages of the fly-shuttle attachment. These are some of the objects on which a beginning could be made. The Department could of course do all this itself without the intervention of the District Associations. But I believe it will be found advantageous to work through the Associations as much as possible in order to give them a more direct interest in the work which they are to foster. I venture to think that their vitality may be stimulated and their utility increased thereby. If this proposal be approved, the Department of Agriculture would allot a lump sum annually to the Governing Body of the Victoria Technical Institute which is the Central Committee of the District Agricultural and Industrial Associations and the Governing Body would allot sums to be applied in specified localities for specified purposes by the District Associations.

10. I have lately suggested that Government should, as an experiment, guarantee the cultivators of cotton seed farms against possible loss of profit due to the cultivation of the crop on the special methods suitable when the production of high grade seed is the principal object. This may involve some additional expenditure, but the amount will not be large because unless such farms can be run at a profit somewhat greater than that obtainable from ordinary cotton cultivation it is not worth while persevering with the experiment. A few years' trial will show whether cultivators are willing to pay a price for the seed which will provide this profit.

* * * *

Programme of Agricultural Enquiry and Experiment in the Districts of the Central Provinces and Berar during the season 1904-05.

PART A.—EXPERIMENTAL FARMS.

NAGPUR FARM.

I.—Description of the Farm.

The Nagpur Experimental Farm was established in 1883, in which year the former Model Farm was given up and the present site selected in its stead. The land is close to Nagpur and is moderately typical of the black cotton soil which is to be found in the Central Provinces. It consists of a fairly level piece of land of about 90 acres in extent, out of which about 70 acres are under cultivation, the rest being occupied by roads, buildings and waste land. The soil is of the black cotton type, but of somewhat inferior quality. It varies in depth from 4 to 10 feet and is situated upon gneiss rock. The natural drainage is, however, bad, in consequence of which crops frequently suffer. The road to Ambhajheri which intersects the farm acts as an embankment which holds up the water. New drains were opened in 1896, but they have not improved the drainage of the farm as much as is desired.

II.—Scheme of Experiments.

(*Vide* Annexure A.)

III.—Cultivation of different varieties of Crops with the object of discovering varieties suited to the Central Provinces and superior to those commonly grown.

Cotton, juar, bajra, wheat, maize, several kinds of pulse and fodder crops are grown in this section. When any variety is shown to be desirable, it is cultivated on a larger area and the produce distributed through the District Agricultural and Industrial Associations for seed.

IV.—Production of hybrid cotton and wheat.

A large number of varieties of these crops, both indigenous and foreign, is cultivated, and the most promising are crossed with the object of producing a hardy cotton with lint of good quality and long staple and a rust-resistant wheat of good milling quality. The best of the crosses are cultivated on an extended scale and when fully tested the seed is to be issued to cultivators through the District Agricultural and Industrial Associations.

V.—Investigation of Plant Diseases.

Diseases appearing in the crops cultivated on the farm are investigated in communication with the Cryptogamic Botanist to the Government of India and special study is made of those most commonly occurring. At present experiments with preventives of smut in juar and rust in wheat are in progress.

VI.—Trial of Implements.

European and native implements likely to be serviceable to the cultivators of the Nagpur country are tried and if proved suitable are advertised by practical demonstration through Agricultural Assistants in the Moffusil.

TELINKHERI FARM.

I.—Description of the Farm.

The Telinkheri garden was originally one of the Raja's gardens and was, after the annexation of the Nagpur country, declared nazul, *i. e.*, the property of the State. The Telinkheri garden was retained and continued to be managed

Note.—Annexures not printed.

by the Local Fund Committee until it was handed over to the Forest Department in 1872. In placing the garden under the management of the Forest Department, Sir John Morris, then Chief Commissioner of the Central Provinces, gave that Department a large area attached to the gardens for the purpose of an experimental plantation.

The Forest Department succeeded in raising a good growth of forest trees on the larger portion of the area reserved for the purpose, keeping a smaller portion for the cultivation of food crops.

II.—Scheme of work.

This farm is used mainly as an adjunct to the Nagpur Farm for the production of seeds of new or improved varieties tested on the Nagpur Farm.

There is only one experimental series, of which the object is the comparison of the results obtained by the several methods of rice cultivation practised in the Central Provinces.

(*Vide* Annexure B.)

POWERKHEDA FARM.

I.—Description of Farm.

This farm measures 127·25 acres and lies 4 miles from Hoshangabad on the Itarsi road. It was purchased in the year 1903 with the object of providing for experimental cultivation of rabi crops under conditions typical of those of the rabi-growing districts of the Nerbudda Valley. Experimental cultivation began in the season 1904-05. The land consists of a black or brown loam (about 40 per cent. sand and 60 per cent. clay) fairly representative of the black soils of the Nerbudda Valley.

II.—Scheme of Experiments.

(*Vide* Annexure C.)

III.—The cultivation of different varieties of Crops and the trial of Implements.

The cultivation of different varieties of crops and the trial of implements are carried out on the same lines as at Nagpur. Arrangements for cross-breeding are not yet made.

LABANDIH FARM.

I.—Description of Farm.

This farm measures 127·10 acres and lies 4 miles from Raipur on the Arang road and was acquired in the year 1903, with the object of providing a site for the experimental cultivation of rice under conditions typical of the Chhattisgarh rice country. The farm lies on a gentle slope below a small tank which, with the assistance of a well below it, will supply sufficient water for irrigation. At the top of the slope the soil is *matasi*, and it passes through *dorsa* to *kanhar* in the lowest part of the area.

II.—Scheme of Experiments.

(*Vide* Annexure D.)

III.—The cultivation of different varieties of Crops and the trial of Implements.

The cultivation of different varieties of crops and the trial of implements are carried out on the same lines as at Nagpur. Arrangements for cross-breeding are not yet made.

PART B.

IMPROVEMENT OF THE BREED OF CATTLE.

1. A cattle-breeding farm for the production of bulls to be used in improving the agricultural stock of the Southern districts was established at Telinkheri in 1902. The farm was stocked in 1902 with a herd of 34 cows, 12 calves and 1 bull. The cows and calves were all purchased from the famous Jaitpur herd of "Gaolao" cattle, which is considered to be the best breed in the Nagpur country. The bull was purchased in the Arvi Tahsil of Wardha; he is the best that could be found, but has some defects. The great difficulty that was experienced in buying a good bull shows the necessity that there is for Government cattle farms. In 1903 the establishment of a second cattle-breeding farm at Hoshangabad was sanctioned. This farm has been stocked with a herd of cattle of the Malvi breed. Cattle of this breed, the home of which is in the Gwalior and Indore States, are largely imported into the Northern Districts as they are the best work-cattle for the deep black soil. The object of these farms is to improve the agricultural cattle of the country by breeding good bulls from a herd of pure bred cattle. It is proposed to hand over the bulls under certain fixed conditions for short terms of a few years to landlords who take an interest in cattle-breeding. It will be necessary to lend sufficient bulls to supply the whole number of cows kept in the selected village. The conditions under which the bulls will be lent are as follows:—

(1) The landlord will be responsible for the proper feed and care of the Government bulls, which will be periodically inspected by the Veterinary Assistant and other Government officers.

(2) The landlord will be responsible for the immediate report of any illness of the bull and of the outbreak of any cattle-disease in the village, but will not be responsible for any casualty which is not due to his neglect.

(3) No bull other than a Government bull, or one approved by the Civil Veterinary Department, must be kept in the village.

(4) All young stock, exceeding two years of age, must be castrated unless they are kept for rearing as bulls separately from the village herd.

PART C.

PROGRAMME OF DISTRICT WORK.

I.—IMPROVEMENT OF THE METHOD OF CULTIVATION OF KHARIF CROPS.

Districts.—Raipur, Bilaspur, Hoshangabad, Chhindwara and Betul.

Five plots are being worked by the Agricultural Department in each district, with the object of demonstrating the best methods of cultivating these crops as used in the Nagpur country (*vide* Part E, I and II).

II.—INTRODUCTION OF NEW CROPS.

District.—Betul.

The cultivation of Sarson (*Brassica campestris*) as an after-crop on land cropped with maize is to be demonstrated on small plots by the Agricultural Department (*vide* Part E, III).

III.—INTRODUCTION OF IMPROVED VARIETIES OF CROPS.

(*Vide* Annexure E).

IV.—EXPERIMENTS TO TEST THE RUST-RESISTANT QUALITIES OF THE CROSS-BRED WHEAT HAURA-MUNDIA PISSI.

Districts.—Narshinghpur, Hoshangabad, Jubbulpore, Saugor, Seoni and Mandla.

Experiments will be continued on the same lines as last. year (*vide* Part E, V).

V.—Ensilage Demonstrations.

Districts.—Hoshangabad, Betul and Chhindwara.

The Agricultural Assistant in charge of the demonstration plots will make silos and pack them with maize stalks and "kans" grass (*vide* Part E, VI).

VI.—Introduction of the Meagher system of sewage disposal.

Districts.—Hoshangabad, Seoni-Malwa, Betul, Badnur and Saugor.

An Agricultural Assistant will be deputed with the necessary implements to each centre, where he will stay for a short period and give a practical demonstration of the working of the system (*vide* Part E, VII).

VII.—Introduction of the practice of fodder cutting.

Districts.—Seoni, Nimar, Hoshangabad, Betul and the six districts of Berar.

An Agricultural Assistant will tour in these districts with a fodder-cutter demonstrating the advantages of cutting up fodder before feeding it to cattle (*vide* Part E, VIII).

VIII.—Demonstration of Winnowimg Machine.

Districts.—Nimar, Hoshangabad, Narshingpur, Betul, Saugor, all Berar Districts and Seoni.

An Agricultural Assistant will tour in these districts with a winnowing machine and demonstrate its use (*vide* Part E, IX).

IX.—The use of Saltpetre as a manure for Rice.

Districts.—Bilaspur, Raipur, Seoni and Sambalpur.

A supply of saltpetre has been sent for use as a top-dressing for rice (*vide* Part E, X).

X.—The use of Saltpetre as a manure for Wheat in irrigated land.

Districts.—Nimar and Jubbulpore.

An assistant will take a supply of saltpetre to the districts named and apply it as a top-dressing to wheat in irrigated land (*vide* Part E, XI).

XI.—The prevention of smut in Juar.

Districts.—Nagpur, Wardha, Chhindwara, Amraoti and Buldana.

Demonstrations of the treatment of seed with sulphate of copper will be made on an extensive scale by all Revenue Inspectors (*vide* Part E, XII).

XII.—Enquiry into Sugarcane cultivation and demonstration of improved method of crushing Cane and making Gur (and enquiry into existing methods of Sugarcane cultivation).

Districts.—Betul and Balaghat.

The Assistant Director of Agriculture will tour in the districts named with a Poona crushing mill and boiling pan and will demonstrate the method of using these implements in the preparation of gur and the construction of the Poona form of furnace. If possible, an Assistant from the office of the Agricultural Chemist with the Government of India will tour with him and test the quality of the juice and gur obtained from different varieties of cane (*vide* Part E, XIII).

XIII.—Irrigation of Rice by Wells subsidiary to Tanks.

District.—Chanda.

Experimental wells are to be worked by Land Record Officers (*vide* Part E, XIV).

PART D.

ABSTRACT BY DISTRICTS.

Saugor.—III. Introduction of Jaunpur maize.

IV. Experiments to test the rust-resisting qualities of the cross-bred wheat Haura-Mundia Pissi. Experiments will be continued on the same lines as last year.

VI. Introduction of the Meagher system of sewage disposal. An Agricultural Assistant will be deputed with the necessary implements to each centre, where he will stay for a short period and give a practical demonstration of the working of the system.

VIII. Demonstration of winnowing machine.

Damoh.—III. Introduction of acclimatized German peas.

Jubbulpore.—III. Introduction of acclimatized German peas.

IV. Experiments to test the rust-resisting qualities of the cross-bred wheat Haura-Mundia Pissi. Experiments will be continued on the same lines as last year.

X. The use of saltpetre as a manure for wheat in irrigated land. An Assistant will take a supply of saltpetre to the district and apply it as a top-dressing for wheat in irrigated land.

Mandla.—IV. Experiments to test the rust-resisting qualities of the cross-bred wheat Haura-Mundia Pissi. Experiments will be continued on the same lines as last year.

Seoni.—III. Introduction of Chaoli and acclimatized German peas.

IV. Experiments to test the rust-resisting qualities of the cross-bred wheat Haura-Mundia Pissi. Experiments will be continued on the same lines as last year.

VII. Introduction of the practice of fodder-cutting.

VIII. Demonstration of winnowing machine.

IX. The use of saltpetre as a manure for rice. A supply of saltpetre has been sent for use as a top-dressing for rice.

Narsinghpur.—III. Introduction of awned bajra and acclimatized German peas.

IV. Experiments to test the rust-resisting qualities of the cross-bred wheat Haura-Mundia Pissi. Experiments will be continued on the same lines as last year.

VIII. Demonstration of winnowing machine.

Hoshangabad.—I. Improvement of the method of cultivating *kharif* crops.

III. Introduction of ganeri juar.

IV. Experiments to test the rust-resisting qualities of the cross-bred wheat Haura-Mundia Pissi. Experiments will be continued on the same lines as last year.

V. Ensilage demonstration. The Agricultural Assistant in charge of the demonstration plots will make silos and pack them with maize stalks and "kans" grass.

VI. Introduction of the Meagher system of sewage disposal (in Seoni-Malwa). An Agricultural Assistant will be deputed with the necessary implements to each centre, where he will stay for a short period and give a practical demonstration of the working of the system.

VII. Introduction of the practice of fodder cutting. An Agricultural Assistant will tour in the district with

a fodder-cutter demonstrating the advantages of cutting up fodder.

VIII. Demonstration of winnowing machine.

Nimar.—III. Introduction of selected Saoner juar, Ganeri juar, awned bajra and Madras groundnut.

VII. Introduction of the practice of fodder-cutting. An Agricultural Assistant will tour in the district with a fodder-cutter demonstrating the advantages of cutting up fodder before feeding it to cattle.

VIII. Demonstration of winnowing machine. An Agricultural Assistant will tour in the district with a winnowing machine and demonstrate its use.

X. The use of saltpetre as a manure for wheat in irrigated land. An Assistant will take a supply of saltpetre to the district and apply it as a top-dressing to wheat in irrigated land.

Betul.—I. Improvement in the method of cultivating *kharif* crops.

II. Introduction of new crops (the cultivation of Sarson as an after-crop on land cropped with maize).

III. Introduction of selected Saoner juar, Ganeri juar, Chaoli, and awned bajra.

V. Ensilage demonstration. The Agricultural Assistant in charge of the demonstration plots will make silos and pack them with maize stalks and "kans" grass.

VI Introduction of the Meagher system of sewage disposal in Betul and Badnur. An Agricultural Assistant will be deputed with the necessary implements to each centre, where he will stay for a short period and give a practical demonstration of the working of the system.

VII. Introduction of the practice of fodder-cutting. An Agricultural Assistant will tour in the district with a fodder-cutter demonstrating the advantages of cutting up fodder before feeding it to cattle.

VIII. Demonstration of winnowing machine. An Agricultural Assistant will tour in the district with a winnowing machine and demonstrate its use.

XII. Enquiry into sugarcane cultivation and demonstration of improved method of crushing cane and making "gur." The Assistant Director of Agriculture will tour in the district with a Poona crushing mill and boiling pan and will demonstrate the method of using these implements in the preparation of "gur" and the construction of the Poona form of furnace. If possible, an Assistant from the office of the Agricultural Chemist with the Government of India will tour with him and test the quality of the juice and "gur" obtained from different varieties of cane.

Chhindwara.—I. Improvement of the method of cultivating *kharif* crops.

III. Introduction of selected Ganeri juar.

V. Ensilage demonstration. The Agricultural Assistant in charge of the demonstration plots will make silos and pack them with maize stalks and "kans" grass.

XI. The prevention of smut in juar. Demonstrations of the treatment of seed with sulphate of copper will be made on an extensive scale by all Revenue Inspectors.

Wardha.—III. Introduction of selected Saoner juar, Ganeri juar, *Sorghum, collier* and acclimatized Georgian cotton.

XI. The prevention of smut in juar. Demonstrations of the treatment of seed with sulphate of copper will be made on an extensive scale by all Revenue Inspectors.

Nagpur.—III. Introduction of Saoner juar, Ganeri juar, *Sorghum collier*, Madras groundnut and acclimatized Georgian cotton.

XI. The prevention of smut in juar. Demonstrations of the treatment of seed with sulphate of copper will be made on an extensive scale by all Revenue Inspectors.

XIII. Irrigation of rice by wells subsidiary to tanks. Experimental wells are to be worked by land Record Officers.

Chanda.—III. Introduction of early paddy.

XIII. Irrigation of rice by wells subsidiary to tanks. Experimental wells are to be worked by Land Record Officers.

Bhandara.—III. Introduction of early paddy.

XII. Irrigation of rice by wells subsidiary to tanks. Experimental wells are to be worked by Land Record Officers.

Balaghat.—III. Introduction of Chinur paddy.

XII. Enquiry into sugarcane cultivation and demonstration of improved method of crushing cane and making "gur." The Assistant Director of Agriculture will tour in the district with a Poona crushing mill and boiling pan and will demonstrate the method of using these implements in the preparation of "gur" and the construction of the Poona form of furnace. If possible an Assistant from the office of the Agricultural Chemist with the Government of India will tour with him and test the quality of the juice and "gur" obtained from different varieties of cane.

Raipur.—I. Improvement in the method of cultivating *kharif* crops.

III. Introduction of Motichura juar, Ganeri juar, cold-season til and early paddy.

IX. The use of saltpetre as a manure for rice. Supply of saltpetre has been sent for use as a top-dressing for rice.

Bilaspur.—I. Improvement of the method of cultivation of *kharif* crops.

III Introduction of Motichura juar, Ganeri juar, Chinur paddy and early paddy.

IX. The use of saltpetre as a manure for rice. A supply of saltpetre has been sent for use as a top-dressing for rice.

Sambalpur.—III. Introduction of Motichura juar, Ganeri juar, Chinur paddy and early paddy.

IX. The use of saltpetre as a manure for rice. A supply of saltpetre has been sent for use as a top-dressing for rice.

Amraoti.—VII. Introduction of the practice of fodder-cutting. An Agricultural Assistant will tour in the district with a fodder-cutter demonstrating the advantages of cutting up fodder before feeding it to cattle.

VII. Demonstration of winnowing machine. An Agricultural Assistant will tour in the district with a winnowing machine and demonstrate its use.

XI. The prevention of smut in juar. Demonstrations of the treatment of seed with sulphate of copper will be made on an extensive scale by all Revenue Inspectors.

Akola.—VII. Introduction of the practice of fodder-cutting. An Agricultural Assistant will tour in the district with a fodder-cutter demonstrating the advantages of cutting up fodder before feeding it to cattle.

VIII. Demonstration of winnowing machine. An Agricultural Assistant will tour in the district with a winnowing machine and demonstrate its use.

Ellichpur.—VII. Introduction of the practice of fodder-cutting. An Agricultural Assistant will tour in the district with a

fodder-cutter demonstrating the advantages of cutting up fodder before feeding it to cattle.

VIII. Demonstration of winnowing machine. An Agricultural Assistant will tour in the district with a winnowing machine and demonstrate its use.

Wun.—VII, VIII } As above.

Basim.—VII. Introduction of the practice of fodder-cutting. An Agricultural Assistant will tour in the district with a fodder-cutter demonstrating the advantages of cutting up fodder before feeding it to cattle.

VIII. Demonstration of winnowing machine. An Agricultural Assistant will tour in the district with a winnowing machine and demonstrate its use.

Buldana.—VII, VIII } As above.

XI. The prevention of smut in juar. Demonstration of the treatment of seed with sulphate of copper will be made on an extensive scale by all Revenue Inspectors.

PART E.

SYNOPSIS OF DETAILED INSTRUCTIONS.

I.—Introduction of Juar and Cotton cultivation in Chhattisgarh.

Districts.—Bilaspur and Raipur.

Reference.—Letter No. 4392, dated the 29th October 1901, from the Director of Agriculture, to the Commissioner, Chhatisgarh Division.

For some few years efforts have been made to introduce juar and cotton cultivation into some parts of Chhattisgarh which seem suitable for these crops. Sufficient advance has been made to justify hopes that some ultimate success may be achieved, but the difficulty in the past has been to induce the cultivators to abandon slovenly methods of cultivation with broadcasted seed in favour of approved methods with seed-drills and other suitable implements. To overcome this difficulty it has been decided that the Department of Agriculture should take up some temporary demonstration farms, where juar and cotton will be grown upon approved methods, as an object-lesson to local cultivators. Five demonstration farms in Bilaspur and five in Raipur have been started, an Agricultural Assistant having been placed in charge of the work in each district. The duties of the Agricultural Assistants are, to grow juar and cotton upon approved methods at the demonstration farms, to fully explain the system to the local cultivators, and to encourage them to follow similar methods in their own fields. The use of the land for the farms is given by the holders, who also supply all labour required for the preparation of the land, etc., in return for which the crop will be made over to them.

II.—Improvement of the method of Cultivation of "Kharif" Crops.

Districts.—Hoshangabad, Chhindwara and Betul.

The cultivators of the Hoshangabad and parts of the Betul and Chhindwara Districts follow a most slovenly system of *kharif* cultivation, the land being badly prepared, five or even more varieties of crop being sown broadcast in the same field, and weeding, if at all done, being done by hand. Under such a system the outturns are necessarily small. In order to introduce the better methods of cultivation followed in the Nagpur country, five demonstration farms have been started in each district under the charge of an Agricultural Assistant.

III.—Cultivation of Sarson as an after-crop in Makka Baris.

In several districts of the north of the Province, Sarson is sown in the Makka Baris after the maize is cut. It yields a respectable profit with small outlay of money or labour, and is particularly well suited for the jungly districts where large Makka Baris are the rule. It is largely grown in Mandla: but is unknown in Betul.

IV.—Introduction of an Improved Variety of Bajra.

Districts.—Betul, Narsinghpur and Nimar.

Trials of many varieties of bajra upon the Nagpur Experimental Farm have established the superiority of the awned variety received from Bombay, a hardy prolific variety, with the great advantage that, owing to the spike being protected by awns, birds do not attack it.

Introduction of a new Fodder-Crop—"Sorghum Collier."

Districts.—Nagpur, Betul and Wardha.

Experiments on the Nagpur Farm have shown that *Sorghum collier* is an excellent fodder-crop which attains very early maturity. The method of cultivation is exactly similar to that of ordinary juar. The seed should be sown as soon as the rains have started at the rate of 12 lbs. to the acre. It will be ready to be cut and used as a green fodder after three months' growth, when the ears of grain have just commenced to form, the land occupied by the crop being thus again available for rabi sowings. A small portion should be allowed to reach full maturity in order to renew the seed-supply. Seed has been distributed for trial by selected cultivators. The results should be reported by the 1st December 1904.

V.—Experiments to test the rust-resistant qualities of the cross-bred wheat Haura Mundia Pissi, and of wheat seed two years old.

Districts.—Saugor, Jubbulpore, Seoni, Narsinghpur, Hoshangabad, and Mandla.

Experiments have been conducted for some years past at the Nagpur Experimental Farm into the rust-resisting qualities of different varieties of wheat. Many varieties of the Central Provinces have been grown with the view of testing their local reputation as a proof against rust, and although no completely rust-proof variety has been procured, many show much greater power than others to resist this disease. It has been found that these rust-resistant varieties are almost invariably poor milling wheats and are less valuable in the market than other varieties. The experiments have, therefore, been carried further by the endeavour to breed by cross-fertilization a fresh variety of wheat which will combine the good milling properties of one parent with the quality of resistance to rust of the other parent. Out of the cross-bred varieties, one raised from *haura and mundia pissi* has shown promise of success; the grain has been highly valued in the local market, and has as yet shown no signs of rust, although it was surrounded by other varieties which were affected by that disease. Samples of this hybridized wheat were, accordingly, sent out for trial. As the conditions of the year were unfavourable to rust, its rust-resistant qualities could not be tested, but the reports received show that in other respects it is a prolific wheat of good milling quality. The experiments should be repeated in the coming season with the seed locally grown in accordance with the instructions contained in the leaflet sent with the seed.

VI.—Ensilage Experiments.

Districts.—Hoshangabad, Betul and Chhindwara.

It has been found that by using old grain bandas as silos green fodder can be kept very successfully. The cattle eat it with great relish, and it is a useful addition to their food in the hot weather.

VII.—Introduction of the [illegible]

Centres.—Hoshangabad, Betul and Saugor.

The Meagher system of sewage disposal has been fully described in Central Provinces Bulletin No. 5 of 1901. The system seems well suited to the profitable disposal of the sewage of small towns. It is proposed to experiment with the system in the municipalities named above. Efforts should be made to select suitable fields. An Agricultural Assistant will be deputed to visit these centres in December 1901—April 1905, making a stay of a fortnight or so at each centre so as to introduce and supervise the practical working.

VIII.—Introduction of the practice of fodder cutting.

Districts.—Seoni, Nimar, Hoshangabad, Betul and Berar Districts.

Experiments at the Nagpur Farm have shown that the feeding of cattle on chopped instead of whole stalks of fodder plants, such as juar, etc., results in a very large saving of fodder, cattle readily consuming the thick portions of the stalks which are refused if given whole. An excellent American Machine—the Harder Ensilage Cutter and Shredder—has also been used for chopping the fodder. Agricultural Assistants will tour in the above districts with a fodder-cutting machine, with which they will give practical demonstrations of the process and its advantages. They will also take with them a round-about bullock gear although the fodder-cutter can be worked by manual labour, in order to show this labour-saving appliance. Assistance will be required from Deputy Commissioners to arrange the tours of these Agricultural Assistants and to enlist the interest of cultivators in the demonstrations.

IX.—Introduction of Winnowing Machines.

In some years when the hot-weather winds are less constant than usual, cultivators experience considerable difficulty in winnowing their grain: and at all times the slow methods now followed involve a waste of labour which could be more usefully employed on the farm in other ways. An efficient and moderately cheap winnower was shown in several districts last year and produced a small demand. The machine grades and cleans the grain besides separating it from the chaff.

X.—The use of Saltpetre as a manure for rice.

Districts.—Raipur, Bilaspur, Seoni and Sambalpur.

Experiments on the Nagpur Farm have shown that saltpetre is a valuable manure for rice. The most profitable application is one of 80 lbs. to the acre given as a top-dressing. The most suitable time to apply this quantity is when transplanted seedlings have established themselves and are about a foot high, whilst in fields sown broadcast, it should be given after the "biasi" operation has been completed and the plants have taken root and commenced to show signs of new growth. The saltpetre should be sprinkled over the rice plot, care being taken to do this at a time when it is unlikely that the water will be drained away within a fortnight or longer. The results should be reported by the 1st January 1905.

XI.—The use of saltpetre as a manure for wheat.

Districts.—Nimar and Jubbulpore.

Saltpetre has also been found in the Nagpur Farm experiments to be a good manure for wheat with irrigation, the most profitable application being 80 lbs. to the acre used as a top-dressing. This quantity should be dropped by hand along the drills at the roots of the plants, when they are about 8 inches high before they commence to form ears. A quantity of saltpetre will be supplied to agricultural Assistants who will tour in the above-named districts. They will select from irrigated fields a plot one chain square of average quality and treat this with saltpetre. Such plots should be marked out with pegs at the four corners. Arrangements should be made through Revenue Inspectors for others that a good number of these plots and the adjoining plots of similar size should be separately harvested and the outturns reported. It is requested that

Deputy Commissioners will give assistance in this matter. The results should be reported by them by the 1st May 1905.

XII.—The eradication of smut in Juar.

Districts.—Nagpur, Wardha, Chhindwara, Amraoti and Buldana.

Enormous losses occur to the juar crop from the disease known as "smut," which can be completely eradicated by the pickling of seed before sowing in a solution of sulphate of copper. Efforts to popularize this treatment have been made by sending out thousands of vernacular leaflets describing the method, but this has not been very successful in inducing cultivators to try the experiment. Another plan is being tried during the current season. All Revenue Inspectors have been summoned for a day to headquarters where they have been taught the method. They have been supplied with some sulphate of copper for the purpose of making free experiments which should be spread over as large a number as possible of the villages of their circles, so that the results may be widespread. They should collect the villagers together, explain the method and induce as many as possible to follow their example with sulphate of copper purchased in the bazars. A prize of Rs. 25 will be given to the Revenue Inspector of each district who shows the best results. Each Revenue Inspector will report immediately after the sowing season, the names of the villages, the names of the cultivators, khasra number and area of each field in which the remedy is used in his circle (*a*) by him with the sulphate of copper given to him gratuitously and (*b*) by cultivators or himself with sulphate of copper purchased. These returns will be verified by local enquiries by the Superintendent of Land Records, Tahsildars and other officers on tour. The final results will be reported in a consolidated return by the 1st January 1905.

XIII.—Enquiry into Sugarcane Cultivation.

Districts.—Betul and Balaghat.

For some years the area under this valuable crop has been decreasing, whilst recent legislation in regard to sugar bounties seems to give a favourable opportunity of endeavouring to revive the growth of the crop. A special enquiry will, therefore, be made into the sugarcane cultivation of the Provinces. The main heads of this enquiry will be:—

(1) the varieties grown;

(2) an analysis of each variety to test its quality;

(3) methods of cultivation;

(4) causes of decrease in cultivation;

(5) diseases;

(6) methods of sugarcane crushing; possibilities of introducing improved iron-roller mills;

(7) methods of gur-making; possibility of introducing improved pans and apparatus.

This enquiry will be entrusted to Mr. Joshi, the Assistant Director of Agriculture. The necessary apparatus for the analysis of sugarcane will be obtained and will be used in the field. A complete set of sugarcane crushing and gur-making apparatus of the best type will be obtained and will be taken on tour by Mr. Joshi for making demonstrations. It is anticipated that during the current year the enquiry will only extend to Balaghat and Betul. The Deputy Commissioners of these districts are requested to collect all the possible information under the above heads, so that it may be ready at the disposal of Mr. Joshi.

XIV.—Irrigation of rice by wells subsidiary to tanks.

Districts.—Raipur, Bilaspur and Sambalpur.

During the visit of the Irrigation Commission to the Central Provinces they enquired whether there was any system of supplementing the irrigation of rice from tanks by wells made below the tank embankment. This system

of irrigation is practically unknown in the Central Provinces. The Irrigation Commission pointed out that the system was widely followed in parts of Madras and Hyderabad, where the agricultural conditions were not very dissimilar to those of the rice tracts of the Central Provinces, that in these parts tanks were the main source of irrigation, that they often failed at the critical moment at the end of the season (like our tanks), but that irrigation was then supplemented by raising water for a single or two waterings from wells sunk below the tank bund. In their evidence, the local officers generally considered such a scheme of irrigation unsuited to local conditions. But the Irrigation Commission were anxious that some experiments should be made to test the possibility of introducing it. A grant of money has been made for this purpose, and in order that we might have more information about this system, Mr. Joshi was sent to the North Arcot District, Madras, to study the matter in that district, where there are the largest number of such wells supplementary to tanks. His report has rather confirmed the doubts of the suitability of the system for the Central Provinces. He shows that, apart from the tanks, the sub-soil water-level of that district is near the surface, that their system of cultivation is very different, and that the rainfall is also very different, being largely from the north-east monsoon of September-October. For the present it will be best to confine experiments to the digging of some kacha wells below tank bunds in the Raipur, Bilaspur and Sambalpur Districts, say about 6 to 10 in each district. The conditions which we should try to secure are—the sub-soil water level should be fairly near the surface, the well should be deep enough to tap this supply, the well should be sunk below the tank bunds, and, if possible, out of the area irrigated by percolation, at a somewhat high level, capable of watering some of the higher slopes. Each well should be about 20 feet in diameter, so as to give room for working more than one water-lift. The Settlement Officers, Raipur and Sambalpur, and the Assistant Settlement Officers, Bilaspur, have been asked to undertake these experiments. Having selected the sites for wells and having got them dug, some official (*e.g.*, the Revenue Inspector of the Circle) should be made to visit them about once a fortnight to report the depth of water in the well and whether the tank is dry or not. This will show what connection there is between the water-supply in the well and the tank. Again, later in the season, if irrigation is required, arrangements should be made to test the possibilities of the well, by actually irrigating as many rice fields as possible, an account being kept of the depth of water in the well before and after use, the area irrigated, labour employed, etc.

The results should be reported by the 1st January 1905.

PART F.

DISTRIBUTION OF WORK AMONGST AGRICULTURAL ASSISTANTS.

PROGRAMME OF AGRICULTURAL EXPERIMENTS, 1904-05.

Assistant No. 1.—(Govind Raghoba).

May.—Selection of five centres for demonstration farms and arrangements connected therewith. The centres should be selected in the Seoni-Malwa Tahsil. The programme of experiments at each centre should be—

(*a*) Improved methods of cultivation of cotton and juar.

(*b*) Ensilage.

(*c*) Testing of cross-bred wheat.

June-December.—Management of demonstration farms.

January.—Demonstration of the manuring of wheet with saltpetre in Nimar.

February-March.—Demonstration of fodder-cutting and winnowing machines in (*a*) Nimar, (*b*) Hoshangabad and (*c*) Narshinghpur.

April.—Demonstration of Meagher system of sewage disposal in selected municipalities.

Assistant No. II.—(Ganpati Narain).

May-December.—Management of five demonstration farms in Betul centres already selected). Programme of demonstrations to be similar to that of Assistant No. I with the addition of demonstration of Sarson cultivation as an aftercrop in *makka baris*.

January.—Accompanies Mr. Joshi on demonstrations of sugarcane apparatus.

February-March.—Demonstration of fodder-cutting and winnowing machines.

April.—Meagher system of sewage disposal at Badnur and Betul.

Assistant No. III.—(Nilkanth Ramchandra).

May-December.—Management of five demonstration farms at centres already selected in the Chhindwara District (along the Badnur Road). Programme of experiments to be similar to that of Assistant No. I.

January.—Manuring of wheat with saltpetre in Jubbulpore District.

February.—Accompanies Mr. Joshi on demonstrations of sugar apparatus in the Balaghat district.

March-April.—Demonstration of fodder-cutting and winnowing machines in Amraoti, Wun and Basim Districts.

Assistant No. IV.—(Narhari Sitaram).

May-December.—Management of five demonstration farms at centres to be selected in Bilaspur District. Programme of experiments to be similar to that of Assistant No. I, but also to include demonstrations of manuring rice with saltpetre.

January-April.—Meagher system of sewage disposal at Saugor. Use of winnowing machine.

Assistant No. V.—(Gopal Balkrishna).

May-December.—Management of five demonstration farms at centres to be selected in the Drug Tahsil of Raipur District. Programme of experiments to be similar to that of Assistant No. IV. He should also assist in any measures for extermination of the grass-hopper pest.

January-April.—Demonstration of fodder-cutting and winnowing machines in Ellichpur, Akola and Buldana.

Sulphate of copper experiments to prevent juar smut in Nagpur, Wardha and Akola.

Land Record Staff to supervise.

PART G.

Investigation of Insect Pests.

An Agricultural Assistant has been under training with the Entomologist to the Government of India. He will investigate the common insect pests of the Central Provinces in communication with the Entomologist to the Government of India and will also be employed in demonstrating methods for their destruction or prevention. Whenever this is possible without interference with his entomological work, he will be employed in connection with agricultural demonstration on the same lines as other Agricultural Assistants.

NOTE ON THE AGRICULTURAL EXPERIMENTS, INVESTIGATIONS AND IMPROVEMENTS BEGUN OR CONTEMPLATED IN ASSAM.

1. Most of the agricultural experiments, investigations and improvements in progress under this Department are carried on in the Khasi and Jaintia Hills, where there are three experimental farms. The three experimental farms are :—

(1) The Upper Shillong Experimental Farm, established in 1897-98,

(2) The Shillong Fruit Garden, established in 1902-03, and

(3) The Tropical Plantation at Wahjain near Theriaghat, established last yoar.

Nos. 1 and 2 are close to tho Shillong station, and are managed together as one and the same concern. The aims and operations of these two farms are described below:—

The Upper Shillong Experimental Farm and the Shillong Fruit Garden.

Introduction of superior varieties of potatoes.

2. Potato is the most important staple of the Khasi Hills. The old stock of potato, which has been grown in the district for over 70 years, has greatly deteriorated, particularly since the appearance of blight in 1885. A large measure of success has been achieved by the Department in introducing the Nainital variety of potato, which has now become common in the district. Several other varieties are under trial, and it is expected some of these will prove valuable. There are 19 distinct varieties of potato under trial at the farm, and three more kinds have been procured this year from England for sowing next season.

3. The Khasi Hills supply seed-potatoes to the rest of Assam, as well as to Western Bengal through Calcutta. An improved potato crop in these hills is, therefore, expected to benefit other districts. A large quantity of seed-potatoes of the Nainital variety is annually distributed by the farm to various localities including the plains of Assam where also the potato is largely raised in the cold weather. Formerly the seed used to be given out free, but now the farm-grown seed is readily sold, and the demand for it is increasing every year.

4. The potato blight has been in the hills since 1885. It is particularly severe on the old stock of Khasi potatoes. Nainital and some other new varieties under trial suffer much less. Six new varieties imported this year from New South Wales are quite free from blight; it remains to be seen if these will remain so in future. To combat the blight, experiments are being made with the Bordeaux mixture. The results obtained last season (1904) showed the remedy to be useful, but a difficulty in its use is the rainy climate owing to which the mixture gets washed off the plants and is unable to exercise its full effect.

Introduction of superior strains of milch cattle.

5. With this view, a herd of cross-bred English cows and a bull from Patna were imported in 1902, and two Bhutia cows in 1903. The Bhutia cows are a cross between a Mithan bull (*Box frontalis*) and the Tibetan cow. Both the breeds are a decided improvement on the local cow which is a very poor milker though its milk is of rich quality. A cross-breed is being produced by crossing local cows and the two Bhutia cows by the half English-Patna bull. It will be some years before the merits of these crosses are known. A few bull calves of the Patna breed have been distributed for breeding purposes, and more animals, both male and female, will be distributed as they become available. A Mithan bull is being procured from the Naga Hills with a view to produce a new cross.

Introduction of an English breed of pigs.

6. Since December 1902, there has been a herd of English pigs at the Experimental Farm. They have been breeding freely, each sow producing two litters annually, averaging eight young at each birth. A large number of these pigs have been sold, and steps are being taken to distribute a number of animals in suitable parts of the Province. The English pigs are greatly superior to the indigenous breeds, but require more attention. Incidentally the value of hog bristles is being brought to the notice of the Assamese.

Cultivation and preservation of fodder.

7. On the plateau of the Khasi Hills, fodder becomes very scarce during the winter. The grass being killed by frost, there is little or no green food to be had and the cattle suffer severely. Experiments have, therefore, been in progress since 1898 to find suitable fodder crops and the means of preserving them for the winter. The crop which has proved most suitable for the purpose is maize, both as green food used during the summer and autumn and as ensilage during the winter. Another useful fodder crop is the sweet potato,

which affords a cheap substitute for grain for cows as well as for pigs and a large quantity of succulent herbage to both. Both these crops are being largely grown at the farm.

8. Ensilage is regularly used at the farm in feeding the cows. Both pit silos and overground tub silos are used. The latter kind is decidedly the better of the two. The experiment with silos will be continued. The local cultivators near the farm have appreciated the value of ensilage. Last year five of them made pit silos, and this year 10 silos (one an overground tub) have been made. The Department has offered two prizes of Rs. 40 and Rs. 20 for the best silos to be competed for by Khasias during the current year.

Introduction of European and other semi-temperate fruits.

9. These are being tried at the Fruit Garden (elevation 5,300 feet) and at the Upper Shillong Experimental Farm (elevation 5,900 feet). They have been in cultivation since last year. It is too early yet to speak of the result of their cultivation excepting a few which have already borne fruit. The early appearance of the rainy season is a difficulty. The following fruit trees are under trial:—Apple, pear, cherry, plum, apricot, peach, grape, gooseberry, raspberry, currant, strawberry, fig, walnut, almond loquat, tree-tomato, cherimoyer and mountain papaya. Plants of several other kinds of fruit have been indented for from England and are expected shortly. These are the American blackberry, the Japanese honeyberry, the loganberry, the Japanese wineberry and the strawberry-raspberry.

10. Apple, pear, cherry, plum and peach are found at Shillong, but they are of inferior quality. It is sought to improve them by grafting, &c. Strawberry and figs have borne fruit and done well and so also the Spanish chestnut of which there has been an old plantation at the farm for many years. Steps are being taken to popularise the cultivation of the Spanish chestnut. An indigenous chestnut grows wild in the district and the nuts, which are very small in size, are sold in the bazars. It is proposed to try grafting the Spanish chestnut on the indigenous stock.

Other crops under trial.

11. *Rhubarb* has been grown successfully at the Fruit Garden during the last two years, and steps are being taken to popularise its cultivation in the Khasi Hills and in the other hill districts.

The cultivation of *wheat, barley and oats* is under trial at one of the establishments near Shillong.

Three varieties of *American sweet potatoes*, of which seed tubers were supplied by the Inspector-General of Agriculture, are under trial. The indigenous varieties of sweet potato are extremely productive and in point of flavour and mealiness seem equal to the best American kinds. The experiment with Americans will, however, be continued.

A large fruited variety of *squash* (*Sechium edule*), which was introduced from Madras last year by the Assistant-Director, has been grown successfully at the Fruit Garden. It is proposed to distribute seed-fruits of this variety next year, and it is expected it will soon supersede the small-fruited variety which has been cultivated here for some years past.

New manures.

12. The soil of the central plateau of the Khasi Hills is of poor quality. In the method of cultivation in vogue, the land is given a long period of rest, and previous to cropping, the turf is pared and burnt. The land is then cultivated for two or three years at longest and again given up. The yield of crops grown on such land is of the scantiest. On the other hand, land which is cultivated from year to year requires to be liberally manured. The only manure available in the district is cowdung, which is held in great value. Few people are willing to sell it, and the price paid for it is very high, a cart-load selling for Rs. 2 or more. There is no doubt that the extension of cultivation in the Khasi Hills is hindered to a great extent by the limited character of the manure supply. It has been the aim of the Department for several years past to find some other profitable manure, particularly for the potato crop, which brings in a large quantity of ready money to the pockets of the cultivators. The use of mustard-cake has been found to pay well, but hitherto the raiyats living round the farm have shown no inclination to adopt it, probably because its use involves a cash

outlay to start with (Rs. 40 to Rs. 50 per acre for 20 maunds of cake). The experiments with oil-cake, or rather the demonstration of its value as a manure for potatoes, will be continued.

It is proposed also to try a new artificial manure for potatoes manufactured by Messrs. Waldie & Company of Calcutta. The price of this manure is Rs. 105 per ton in Calcutta, landed at the farm ; the price will be about Rs. 6 per maund against Rs. 2 to Rs. 2-8 at which mustard-cake is available.

Insect pests.

13. Vegetables and orchard trees in Assam are excessively subject to a host of insect pest, the most destructive of which are the black cut worm, the grub of the large ground beetle, a species of red ant, and numerous varieties of beetles, large and small, which swarm during the spring and early summer months. A continual fight has to be maintained with these pests. Hand-picking, wherever possible, is resorted to, and such well known remedies as kerosine emulsion, diluted kerosine and Paris-green are being used. Specimens of the insects have been sent at various times to the Entomologist to the Government of India, but no practicable remedies have yet been found. Perhaps if the Entomologist could visit Assam during May and June, he might be able to suggest a cure.

Sericulture.

14. Some very successful experiments were made last spring in rearing silk-worms from seed imported from France. This is the univoltine worm and the seed has to be hibernated where there is frost, *i.e.*, in the hills. The cocoons raised were sent to France for valuation and considered equal to the best available in the French market. They were valued at about Rs. 240 per maund of dry cocoons, which is equivalent to Rs. 80 per maund of green cocoons, as against Rs. 20 which is the usual price for cocoons in the silk-rearing districts of Bengal and Rs. 15 paid by the Kashmir Government. Arrangements have been made to repeat the experiments next year. Silkworm rearing is peculiarly a cottage industry, and it is expected the Khasias, who are receptive of new ideas, will take to it. The chief obstacle to the expansion of the industry is the paucity of mulberry trees in the district. Steps are being taken to encourage the planting of mulberry wholesale, and rewards have been offered for new mulberry plantations to be competed for next year.

Agriculture.

15. The Khasi and Jaintia Hills district is one of the very few places in India where bees are reared for honey. The method of rearing in vogue is, however, of a primitive character. Experiments are in progress with English hives and the English method of rearing the bees. In making this experiment we have had to depend largely on book knowledge. The assistance of a practical bee-keeper would be of great service in this matter. Swarms of bees have been sent to the plains for trial and improved English hive has also been sent to be tried in the plains as soon as a swarm can be procured.

Dairy.

16. A Government dairy has been in existence at Shillong since July 1900. It was started as an appanage of the Experimental Farm, but since April 1903 it has been leased to a private individual though it continues subject to the supervision of the Department. Butter and cream-cheese, both of excellent quality, are produced at the dairy and find a ready sale and are sent by post all over the Province. Financially the dairy has proved exceedingly profitable, having paid back the capital many times over. It has led to the establishment of a rival private dairy, which too is believed to be doing well. The dairy has long since passed out of the experimental stage, and there is no particular object in maintaining it longer as a Government concern. But the Department has in contemplation the building of a model dairy-house, and when this is done, the dairy will be made over to a private individual possessed of the means and knowledge for running a business of the kind.

The Tropical Plantation at Wahjain.

17. This plantation is situated on the southern slope of the Khasi Hills at an elevation of about 1,000 feet. The climate is tropical and unlike that of Shillong which may be described as of a temperate or semi-temperate character. The tropical plantation was started in the beginning of the current year.

Most of the crops under trial are grown in Ceylon or Southern India, from which places seeds and plants have been obtained. The plants under trial are the following :—

A.—Spices	Cinnamon.
	Lesser cardamom.
	Greater cardamom.
	Nutmeg.
	Clove.
B.—Drugs	Cocoa.
	Coffee.
	Camphor.
C.—Tropical fruits	Natal orange (a large seedless orange imported from Durban).
	Kew and Ceylon pine-apples.
	Bangalore papaya.
	Grafted mango.
	Grafted litchi.
	Sapota.
	Persimmon.
	Superior varieties of banana.
	Breadfruit.
	Durian.
	Rambutan (a species of litchi grown in Ceylon).
	Soursop, Cherimoyer, Tree tomato } Also being tried at Shillong.
D.—Miscellaneous	Arrowroot.
	Caravonica cotton.

It is too early yet to obtain results. Many of the trees will not bear fruit before 8 or 10 years, and some like the nutmeg and clove take 20 years or more to come into bearing.

18. The results of cultivation of Caravonica cotton, Ceylon and Kew pine-apples and Bangalore papaya are expected to be known next year. Arrowroot and coffee cannot be said to be experimental crops. Some Khasia cultivators have been growing them on a small scale for years and would no doubt extend operations if they could secure a market. The coffee grown has a very good flavour and the arrowroot is excellent. The Department is trying to assist them and is in correspondence with the Reporter on Economic Products to the Government of India on the subject. A great deal of locally grown coffee has been sold this year within the Province, and a limited demand for arrowroot has arisen. But the local demand is after all very small and a larger market must be found for these products. It is proposed to send a large consignment of arrowroot and coffee to Calcutta out of the present year's crop, and another consignment, if possible, through the Reporter to London.

Other Agricultural Experiments.

19. As already noted, the bulk of the experimental work in which the Department is engaged is carried on at the three experimental farms. For experiments in outlying places the Department is in need of travelling inspectors or similar agencies for supervision. But European planters and some enterprizing native gentlemen have assisted in the past and might indeed be invited to co-operate more extensively. But it is not quite the same thing as experiments under the Departmental officers. The following is a note of the experiments now being made at places other than the farms.

Potatoes.

20. Efforts are being made in the Naga Hills and the Garo Hills to introduce the cultivation of potatoes. In the Naga Hills, some measure of success has already been obtained. In the Assam Valley, particularly in Upper Assam, the cultivation of this important crop is well established and is believed to be on the increase. A large quantity of seed potatoes is supplied annually by the Upper Shillong Farm to all parts of the Province.

Wheat, barley and oats.

21. Wheat is as yet unknown in Assam except in two districts, *viz.*, Goalpara on the Bengal Frontier and the Native State of Manipur on the extreme south-east of the Province. Efforts are being made to introduce its cultivation in various other parts of the Province. During the current season, experiments are in progress in Kamrup, Jorhat, Tezpur, Dibrugarh, the Naga Hills, the Lushai Hills and Shillong. Side by side with wheat, oats and barley are also being tried at several of these places.

Cotton.

22. Three varieties of cotton are being tried in different parts of the Province, *viz.*, Nausari cotton of which the seed was supplied by the Inspector-General of Agriculture, and two varieties of perennial cotton procured from Queensland named Caravonica cotton Nos. I and II. Caravonica is a perennial cotton greatly extolled by its producer, a Mr. Thomatis of Queensland. It has been sown in various parts of the Province. As yet it is only possible to say that in a number of cases it is thriving.

Jute.

23. The Department is now considering the question of encouraging the cultivation of this important staple in the upper districts of the Brahmaputra Valley.

Tea in the Khasi and Jaintia Hills.

24. Arrangements have been made with a European planter for trying the cultivation of tea on the higher plateau of the Khasi Hills (elevation 6,000 feet). Seed is being procured from the Lushai Hills and will be sown early next spring.

Veterinary work and cattle breeding.

25. There is no Veterinary Officer attached to the Department. There is a Veterinary Surgeon employed by the Local Boards of one district. It is proposed to secure his services for this Department, and negotiations are proceeding on the subject between the Local Administration and the Inspector-General of the Civil Veterinary Department. One of the duties of this officer has been to inoculate cattle against rinderpest, and to a great extent he has succeeded in popularizing this preventive method of treatment in the Sibsagar District.

26. Beyond supplying a number of breeding bulls from Northern India and the breeding work in progress in the Farm at Upper Shillong, the Department cannot claim to have done much towards the improvement of the local breeds of cattle. At present there are 11 breeding bulls at work in the Province, besides the half English-Patna bull at the Farm. Of these 11 bulls six were recently obtained from Sitamarhi and are the property of the Dhubri Local Board. The bulls imported in previous years are not very suitable, being of heavier builds than the local breeds of cattle which are of a diminutive size. Some of them are reported to be doing good work, others are indifferent or of no value. The Sitamarhi bulls are expected to be more suitable. A proposal is under consideration for establishing a breeding and rearing depôt in accordance with certain suggestions recently made by the Inspector-General of the Civil Veterinary Department, but nothing can be done until the Department has been provided with a Veterinary staff, for which application has been made to Government.

27. In the foregoing notes mention has already been made of some of the points on which the Inspector-General of Agriculture has invited special remarks in his letter No. 1336—8-7, dated 25th November 1904.

The first of these points is: (*a*) Measures for bringing the agricultural experts of the Imperial Department into closer touch with the work of the Provincial Departments. One method that suggests itself is that the experts should pay visits to the Province concerned and confer with the local officers. The annual meeting of the Board is undoubtedly another. There should be a free interchange of reports, bulletins and pamphlets on agricultural subjects.

As to (*b*) measures for regulating the work of the Pusa Research Institute, College and Farm, so as to be of the greatest use to the several Provinces; it is to be assumed that the Local Government will encourage local students to

study at the College by scholarships and the promise of employment. The Assam Administration has already granted appointments in the executive service to men who have qualified at Agricultural Colleges. More might be appointed after training at the Pusa College.

Of the measures which might be adopted to bring the Department into closer touch with the agriculture of Assam, the following are a few only of such as are practicable in a small province :—

(i) To establish an Agricultural journal appearing monthly to be edited in vernacular or better still in two vernaculars with a simultaneous English version. This is a great want. There should be some means of communicating with the people at large and to allow of the people communicating with the Department. The journal would be under the control of the Department. It would publish news important to agriculturists, answer their queries, invite experiments with new crops, and either furnish seed or indicate where it is obtainable. The results of agricultural exhibitions might be reported and other news of interest included. The Journal would serve many other purposes too numerous to mention. As to circulating the Journal, it might be distributed to all Revenue Officers and free to Patwaris (or Mandals as they are locally called).

(ii) To appoint a staff of Travelling Inspectors or Demonstrators. Such men would give assistance in (say) the trial of a new crop and explain how to sow and cultivate it and where necessary how to prepare the produce for market. They would also report to the Department the progress and results of experiments. For making experiments with new crops this Department is lamentably short-handed, and it is difficult to supervise them, or rather for want of such officers it is difficult to initiate experiments in many places where they are needed.

(iii) Besides the above-mentioned Technical Journal there should be some regular system of issuing communiqués to the general press. There are several regular newspapers issued in Assam.

(iv) One or more farms should be established in addition to those described already. But the establishment of new farms cannot be undertaken before additional staff is forthcoming.

F. C. HENNIKER,

Director, Department of Land Records and Agriculture, Assam.

SHILLONG :
December 1904.

NOTE ON THE PROGRAMME OF AGRICULTURAL WORK IN BURMA, 1905.

1. At present the agricultural work of the department is principally confined to the maintenance of experimental gardens, experiment throughout the country in the introduction of new crops or varieties and the holding of agricultural shows.

2. *Experimental gardens.*— There are 6 experimental gardens maintained by Government, the financing and, to an extent, the supply of seeds being arranged by the Director of Land Records and Agriculture, while the supervision is entrusted to local officers. The gardens are situated as follows :—

(i) Taunggyi (Southern Shan States).
(ii) Falam (Chin Hills).
(iii) Sinlumkaba (Bhamo District).
(iv) Katha (Katha District).
(v) Myitkyina (Myitkyina District).
(vi) Sima (Myitkyina District).

Of these the Taunggyi garden is by far the most important. Carefully nurtured at its inauguration by the Superintendent Mr. Hildebrand—a keen gardener—this garden has met with a large measure of success, and it has formed an excellent object-lesson to the chiefs who have keenly taken up various new forms of cultivation. The garden is now under European management and even better results may be anticipated. Its full value will however be realized when the opening of the Southern Shan States Railway will permit of the more extensive export of those products which the garden has attempted with success and which the people will then doubtless take up on a large scale. As it is the garden has reached the stage of being able to sell supplies of young plants and trees to outside districts while the sphere of its influence is limited not merely to the garden but extends to the various States in the Superintendency. In fact so securely is potato growing, originating from the garden, established in the States that the crop will now be abandoned in the garden, except for local requirements, as the surplus crop cannot profitably compete with that grown by outside farmers. This is, though unprofitable, most gratifying and shows that in this branch of cultivation at least the garden has served a most excellent purpose. *Of other successes in the garden or in the States mention may be made of sweet* potatoes, coffee (Arabian), barley oats and linseed. *Cherimoyers* have done very well: *Apricots* are beginning to fruit: *Peaches* and *Apples* have done fairly well as also *Plums*. *Strawberries* are a well established crop and young plants are sold to other parts of the Province.

On the whole this may be regarded as our most successful Government venture, and the reason for this are:—

(1) the excellence of the climate,
(2) the energy shown by successive Superintendents,
(3) the keen interest shown by chiefs who have profitted by the object-lesson and have introduced into their own States many of the new crops which have been found to succeed in the experimental garden.

It is proposed to continue the support which has been given in the past to this garden, and it is hoped that under Mr. Colycar a certain number of apprentices may be trained who will be available for employment in other gardens as occasion arises. Already the head gardener, a Burman, is employed as a sort of travelling adviser to the chiefs. There is no doubt that the garden has served a most useful purpose, the full effects of which will be seen when a Railway opens up the country and brings the States into closer touch with a market.

3. The Falam garden is now in its fifth year. Potatoes are a distinct success and there is a considerable market. Plums did well and successful grafting from the cultivated to the wild peach has been carried out. The best successes are achieved with trees obtained from Taunggyi. Vegetables also have succeeded: wheat has been tried with fair success and barley cultivation is very hopeful and is being persevered with.

4. In Katha potatoes have not succeeded, but vegetables and strawberries have done well and have found a ready market. Manila hemp has also done fairly well. This garden is in its third year: it has hardly been long enough established to affect to any extent local methods of cultivation.

5. The Bhamo garden is now in its fifth year and shows its best successes in the hardier kinds of fruits—pears, apples and nuts. There is a good opening for these and they are likely to be eagerly taken up by the Kachins who at present make long journeys into China to get these fruits. Steps are being taken to distribute young stock amongst intelligent headmen. This will help the local industry and be one of the main utilities of the garden. Grafts and cuttings have been extensively made and will be continued. Potatoes here too do well as vegetables which cannot however find a market on account of the large number of private gardens in Bhamo.

6. The Myitkyina and Simla gardens are also thriving and doing well, especially in fruit trees. Strawberries *also are succeeding, as also vegetables and* potatoes.

7. All these gardens it is proposed to continue and maintain during the coming year. Unfortunately from their remote situation it is somewhat difficult to give that amount of personal inspection and supervision which

might be desirable. The Taunggyi and Falam gardens are too distant from the beaten tract to be inspected without undue interference with the already extended labours of the Director. The Department is fortunate in having in these places Civil Officers who take a keen interest in the work, while it is noticeable that, the remoter the situation and the more segregated the tribes, the greater is the interest evinced by the people and the keener the imitation. The Department will, as in the past, continue its financial assistance and so far as possible help with its advice. The other gardens are more or less on the beaten track, and these the Director visits and gives advice on the ground.

8. Proposals are on foot, but have not yet taken definite shape, for the establishment of an experimental garden at Thandaung in the Toungoo district of Lower Burma. This is gradually becoming an important sanitarium for the business people of Rangoon. It is hoped that it may be possible to enlist the assistance of the Rangoon Trades Association in the matter. The proposal has the approval of the Department and it may take definite shape during the next year. It will be the first experiment of its kind in Lower Burma and will contain the elements of commercial success as having easily accessible markets for its produce both in Toungoo and perhaps ultimately in Rangoon. A scheme which has been mooted but has not so far received any practical support is for a botanical garden in Sagaing. This has not been encouraged. There is no point in growing plants when it is well known they will grow naturally as in Sagaing and the Agri-Horticultural Society in Rangoon fully meets the requirements of the Province.

Distribution of Seeds.

9. This is one of the principal concerns of the Department and there is a considerable demand from all parts of the country for seeds of various kinds. *English vegetable seeds* are largely distributed in Upper Burma and as a result the cultivation of these all over the country has been largely extended.

Wheat.—Applications for wheat seed which is already a well established crop in several districts are from time to time received from other districts and in most cases the experiment succeeds.

Tobacco may be said to be the crop in which the department has achieved its most pronounced successes. Not much success has been achieved with Virginia seed but Havana is well established, especially in Ma-ubin and the delta islands of the Irrawaddy. In fact so firmly is the industry established in Ma-ubin that further supplies of seed are not now required, the planters having enough from the old plants not only for their own requirements, but also to sell to outsiders. It is hoped that in time the whole riverine tract will show similar results. Mandalay, in Upper Burma, has been very successful and there is every prospect of ultimate success in all districts with island belts. The department proposes to continue the supply of seed up to the limits of local demand.

Tea.—Experiments with tea have not so far been on a large scale, but in the more hilly districts there is a considerable interest in the cultivation, and during the coming season 120 lbs. of seed from Kurseong will be distributed.

Coffee was at one time a well established industry in Toungoo under Mr. Petley, but blight played havoc with it. The department still perseveres with it in selected districts with fair success, and this year 120 lbs. of Mysore coffee has been distributed. Arabian coffee acclimatized succeeds excellently in Rangoon gardens, and seed from them is also this year being distributed to selected districts.

It is proposed during the year also to carry on experiments in Upper Burma with *American sweet potatoes*. *Ground-nut* originally imported from Pondicherry is now firmly established and the acclimatized seed from Myingyan continues to be tried with success in other districts of Upper Burma. In Minbu the crop is most successfully established.

Experiments are also being tried this year in Myingyan and Meiktila with *Soy Beans* obtained from Assam, and with *Italian and French Haricot Beans*: while a small parcel of Europe beans has been distributed for experimental cultivation at the request of a local firm. In the dry zone a success with any

particular variety of bean or pea is quickly noted by cultivators who eagerly take up new and improved varieties. The Rangoon market for beans is a fairly brisk one.

Further experiments with jowar or millet are not being attempted. It is found that the indigenous variety best suits the requirements of the people. Attempts are however made from time to time to grow one class of seed peculiar to a particular district in another, but with no great measure of success.

Experiments with barley and linseed are being continued in the Southern Shan States. Amongst minor experiments being carried on may be mentioned *China Guava* in Myingyan, *Date palms* in Lower Chindwin and Myingyan, *Avacada Pears* in the Agri-Horticultural Gardens and in Prome, Katha and Southern Shan States. *Lucerne* and *Guinea grass* are being tried in Mandalay and Maymyo, while *Rhea grass* has been tried in Toungoo. Experiments on a small scale are also being carried on with *Sisal* and *Manila hemp*.

10. *Cotton.*—In sympathy with the revival of interest in the cotton industry at home an increasing attention is being devoted by the Department to the various possible means by which the crop can be improved. In this they have received no small help from the entrance into the field of various new firms, principally the Burma Cotton Company whose agents are the large firm of Messrs. Finlay Fleming and Company. Action has already been taken on the lines indicated by the Government of India in their letter No. 23—9-36, dated 16th September 1904:—

1. By communicating the principles therein laid down to the principal cotton-buying firms who also act as distributors of seed.
2. By giving money advances from the Government grant of Rs. 5,000 to the principal cotton-growing districts.

In this way it is hoped that by the selection only of the best seed the general quality of the indigenous crop will be improved.

Messrs. Finlay Fleming in their compound at Myingyan are also experimenting with the various kinds of foreign cottons, sea island, Egyptian, &c., and the results of these experiments will be duly noticed. This plot really meets the objects of an experimental farm to a large extent with the additional advantage that its results are seen by the large crowds of cultivators bringing their ordinary supplies to the mill. In this way the people can judge for themselves what are the best varieties of cotton and what will prove the most profitable.

Experiments on a small scale are also to be carried out this year with Sea Island cotton in Bhamo and other districts of Upper Burma and with the Pernambuco tree cotton. So far this latter variety has not been taken up to any extent in Burma, but it seems probable that it might succeed in Tenasserim and Arakan. These two divisions will be visited during the coming season by the Director or Assistant Director and the whole question considered locally.

11. *Sericulture* has not succeeded in Burma. Last year 100 ounces of silkworm eggs were obtained from France and distributed to the five chief centres of the silkworm industry—Prome, Toungoo, Magwe, Pakôkku and Thayetmyo and also a small quantity to the Agri-Horticultural gardens, Rangoon. The results were uniformly discouraging. The cause of the failure is no doubt chiefly the unfavourable climatic conditions and also in part the ignorance of the local silkworm breeders. It is thought that perhaps the experiment might succeed in the Southern Shan States which possess a more temperate climate approaching in some degree that of Kashmir. A small consignment of 20 ounces has accordingly been sent this year to the Shan States and the result of the experiment is awaited with interest. But it is felt that to ensure success on any large scale the services of a trained expert must be obtained. This point will be considered when the result of the experiment in the Shan States is known.

Agricultural and live-stock shows.

12. These form a principal work of the Department and are steadily growing in popularity and usefulness. They will be held during the coming year at—

1. Kyonpyaw in the Bassein district for the Irrawadday Division.
2. Sagu in the Minbu district for the Minbu Division.

3. Lotpadan in the Tharrawaddy district for the Pegu Division.
4. Pyawbwé in the Yamèthin district for the Meiktila Division.
5. Bhamo for the Bhamo and Myitkyina Districts.
6. Taunggyi for the Southern Shan States.

In addition Government gives a grant of Rs. 500 to the Rangoon Horse Show. The programmes for these shows are drawn up by the District Officer in consultation with the Director of Land Records and Agriculture and the Superintendent, Civil Veterinary Department, and one or both of these officers attends all of these shows. The shows are now well established and are attended by crowds of people who take a keen interest in the judging of stock and the awards. The Inspector-General, Civil Veterinary Department, gives a grant of Rs. 1,000 for cattle breeding classes and also several silver medals: the Superintendent, Civil Veterinary Department, gives an allotment for pony breeding, the progeny of Government stallions, and these and the ordinary Government grants are supplemented by prizes of cups and medals from local donors. The popularity and utility of these shows is now well assured and there is evidence that they are inducing greater care in selection and breeding of stock.

Irrigation Farms.

13. Action has also been taken on the lines indicated in Government of India letter No. 2—5-1, dated the 10th January 1904, with reference to the recommendations of the Irrigation Commission as contained in Chapter XI of their Report on the subject of hydraulic and agricultural experiments. Suitable sites have been suggested in the great canal tracts of the Province and it has been resolved to start work as soon as possible on one of them in the vicinity of Mandalay. I have been directed to discuss with the Inspector-General of Agriculture the detailed working of the scheme and also the provision of a staff. It is proposed that once the firm is fairly started it might be made the centre for an agricultural school where young Burmans might be trained and subsequently qualify for farm managership. A sum of Rs. 10,000 has been placed at my disposal for the current year and I should be glad to be favoured with advice of members of the Conference who have had experience in the working of similar farms in other Provinces.

14. Amongst miscellaneous work the Department has in hand a revision of the Bulletin on the principal crops of Burma, while if the agricultural school is started it will be necessary either to compile a Manual of Agriculture or translate into Burmese some recognized primer.

15. With regard to the several points raised in paragraph 2 of Inspector-General of Agriculture's letter No. 1326—4-8 of 1904, dated the 25th November 1904, I would make the following suggestions :—

As regards the first point raised this present Conference will be a first step in bringing the agricultural experts into closer touch with Provincial Departments. So far as Burma is concerned it was with regret that we learned that Mr. Mollison was prevented by ill-health from making his proposed tour in our province.

A visit from the Inspector-General would be much appreciated and would be most helpful in the solution of many questions, principally in connection with cotton, to which great attention is now being devoted. Apart from a visit of the Inspector-General we have to acknowledge with thanks the assistance in the way of advice and analysis which we have from time to time received. I do not see that apart from tours of the Imperial officers we can expect more than that Provincial Departments can always freely approach the officers of the institute and submit particular questions to them for opinion and advice.

16. As regards measures for regulating the work of the Pusa Research Station College and Farm so that it may be of the greatest use to the several provinces, one of the principal helps will I think be the annual publication of the results of the various experiments which have been carried out at Pusa. In this way local officers will have a standing record of experience from which they can draw to suit local conditions.

17. In the second place I would suggest that the Farm be at all times open for the carrying out of experiments which Provincial Directors may wish tried. In this way trials can be carried out under the best expert supervision and the local officers will know on the result of the experiment at Pusa whether the process can be profitably attempted locally. As an instance of what I mean the Institute might perhaps take up the indigenous Burman cotton (Wagale) which is said to have too short a fibre to prove a commercial success. Experiments might be made to see whether by any process of cultivation the length of the staple could be improved. If an area [to be annually notified by local officers together with their annual programme of experiments] were set apart on the Farm for each Province, much good would undoubtedly result. Provincial Officers should be requested to submit annually to the Inspector-General of Agriculture a list of the experiments which they wish to be tried during the year and the Council of the College could decide what experiments were to be taken up and what area should be allotted to each Province.

18. Another very useful work which in process of time might be completed would be an Agricultural Survey of India. Local officers should be requested to submit specimens of all the various soils in their province together with climatic and rainfall statements. The chemical and agricultural experts to the Institute would be able to submit not only a chemical analysis of the soil but an agricultural note on the crops which the soil ought to produce. If these analyses and specimens were stored in the Provincial Museums they would be a most valuable aid to the agriculture of the country.

19. Finally the issue of Bulletins or leaflets on the various crops of the different Provinces couched in simple language and translated into the various vernaculars would be of the greatest assistance. As a beginning I would suggest a monograph on the collection, drying and preservation and on the selection of various seeds. Recently in Burma we had to refer to India for information as to the best methods of drying and storing cotton-seed. An authorized programme of work in this line to be undertaken annually might be drawn up: the work being done as far as possible locally and the pamphlet revised and completed at Pusa. For instance the first bulletin might be on paddy: second on cotton: third on sessamum, and so on. These would be drawn up for each province by a member of the agricultural staff: and should be as full and practical as possible. The programme of contents might be decided at Pusa so as to secure uniformity. In this way we would in time have for every province and for the whole of India an exhaustive library of agricultural information.

20. As regards the third point raised in the Inspector-General's letter nothing further can at present be done in Burma until, by demonstration on an experimental farm, we can show to the cultivator the advantages of improved methods of cultivation. Already a certain amount has been done by the experimental gardens and in particular districts by the success of the introduction of certain crops which the Department has considered suitable to the local conditions of a particular district. A notable success has been the eagerness with which in flooded tracts the cultivation of "Tadaung-bo" paddy—a paddy which will grow in any depth of water—has been taken up. But further developments in this line must I think wait till experimental farms are well established. At present the interest taken in the distribution of seeds shows that the cultivators appreciate our efforts, but there can be no doubt but that they will do so more and more when we can show them by our own success the soundness of the methods we advocate.

J. MACKENNA,

Director of Land Records and Agriculture, Burma.

RANGOON:
The 11th December 1901.